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VOL. XI.

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AMERICAN GEOGRAPHICAL SOCIETY.

OFFICERS AND COUNCILORS,
1879.

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CLARENCE KING.

V

CONTENTS.

CHARTER OF INCORPORATION.

Granted April 13th, 1854.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. George Bancroft, Henry Grinnell, Francis L. Hawks, John C. Zimmerman, Archibald Russell, Joshua Leavitt, William C. H. Waddell, Ridley Watts, S. De Witt Bloodgood, M. Dudley Bean, Hiram Barney, Alexander J. Cotheal, Luther B. Wyman, John Jay, J. Calvin Smith, Henry V. Poor, Cambridge Livingston, Edmund Blunt, Alexander W. Bradford, and their associates, who are now or may become hereafter associated for the purposes of this act, are hereby constituted a body corporate by the name of The American Geographical and Statistical Society, for the purpose of collecting and diffusing geographical and statistical information.

§ 2. For the purposes aforesaid, the said Society shall possess the general powers and privileges, and be subject to the general liabilities, contained in the third title of the eighteenth chapter of the first part of the Revised Statutes, so far as the same may be applicable, and may not have been modified or repealed; but the real and personal estate which the said Society shall be authorized to take, hold and convey, over and above its library, and maps, charts, instruments and collections, shall not at any time exceed an amount the clear yearly income of which shall be ten thousand dollars.

§ 3. The officers of said Society shall be a president, three vice-presidents, a corresponding secretary, a recording secretary, a librarian, and treasurer, and such other officers as may from time to time be provided for by the by-laws of the said Society.

§ 4. The said Society, for fixing the terms of admission of its members, for the government of the same, for changing and altering

the officers above named, and for the general regulation and management of its transactions and affairs, shall have power to form a code of by-laws, not inconsistent with the laws of this State, or of the United States; which code, when formed and adopted at a regular meeting, shall, until modified or rescinded, be equally binding as this act upon the said Society, its officers, and its members.

§ 5. The Legislature may, at any time, alter or repeal this act.

§ 6. This act to take effect immediately.

STATE OF NEW YORK, } *ss.*:
Secretary's Office, }

I have compared the preceding with the original law on file in this office, and hereby certify the same to be a correct transcript therefrom, and of the whole of said original law.

Given under my hand and seal of office, at the city of Albany, this [L. S.] thirteenth day of April, one thousand eight hundred and fifty-four.

A. G. JOHNSON,
Deputy Secretary of State.

AMENDED CHARTER.

PASSED APRIL 8TH, 1871.

STATE OF NEW YORK, No. 237, IN SENATE, *March* 7, 1871.—Introduced with unanimous consent, by Mr. Bradley; read twice, and referred to the Committee on Literature; reported favorably from said committee, and committed to the Committee of the Whole.

CHAP. 373.

AN ACT in relation to The American Geographical and Statistical Society.

PASSED April 8th, 1871.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. The name or corporate title of the said Society shall hereafter be The American Geographical Society of New York.

§ 2. The object of the said Society shall be the advancement of geographical science; the collection, classification, and scientific arrangement of statistics, and their results; the encouragement of explorations for the more thorough knowledge of all parts of the North American continent, and of other parts of the world which may be imperfectly known; the collection and diffusion of geographical, statistical and scientific knowledge, by lectures, printed publications, or other means; the keeping up of a correspondence with scientific and learned societies in every part of the world, for the collection and diffusion of information, and the interchange of books, charts, maps, public reports, documents and valuable publications; the permanent establishment in the city of New York of an institution in which shall be collected, classified and arranged, geographical and scientific works, voyages and travels, maps, charts,

globes, instruments, documents, manuscripts, prints, engravings, or whatever else may be useful or necessary for supplying full, accurate and reliable information in respect to every part of the globe, or explanatory of its geography, physical and descriptive; and its geological history, giving its climatology, its productions, animal, vegetable and mineral; its exploration, navigation and commerce; having especial reference to that kind of information which should be collected, preserved, and be at all times accessible for public uses in a great maritime and commercial city.

§ 3. The power given by the act hereby accorded to the said Society, to take, hold, convey, manage and make use of its real and personal estate, shall be understood as authorizing said Society to take and hold by gift, grant, bequest, devise, subject to all provisions of law relative to devises and bequests by last will and testament, or purchase real estate to the value of three hundred thousand dollars, and to invest its income, or its personal estate generally, so as to produce a regular annual income sufficient for the accomplishment of the purposes set forth in the first section of this act ; but said annual income shall not exceed twenty-five thousand dollars annually.

§ 4. The said Society shall make an annual report of its proceedings to the Legislature.

STATE OF NEW YORK,
Office of Secretary of State, } *ss.* :

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom, and of the whole of said original law.

[L. S.] Given under my hand and seal of office, at the City of Albany, this twenty-second day of May, in the year one thousand eight hundred and seventy-one.

DIEDRICH WILLERS, JR.,
Deputy Secretary of State.

BY-LAWS.

CHAPTER I.

TITLE.

The title of the Society is, "The American Geographical Society."

CHAPTER II.

OBJECTS.

The objects of the Society are, "The collecting and diffusing of geographical and statistical information."

CHAPTER III.

MEMBERS.

1. The Society shall consist of fellows, honorary, corresponding and *ex-officio* members.

2. Honorary members shall be chosen on account of their distinction in the science of geography or statistics, and not more than twelve of them shall hereafter be elected in any one year.

3. Corresponding members shall be chosen from those who have aided the advancement of geography or statistics.

4. *Ex-officio* members shall be foreign diplomatic representatives and consuls resident in the United States; and United States diplomatic representatives and consuls in foreign countries.

5. Fellows and corresponding and honorary members shall be elected as follows: All nominations of candidates shall be openly made in writing at a meeting of the Society, or the Council, by a member thereof, and, together with the name of the member making them, entered on the minutes. The persons thus nominated, when approved by the Council and elected by the Society, shall, on payment of the initiation fee, if nominated as fellows, and without such payment if nominated as corresponding or honorary members, become members of the Society accordingly.

6. Persons entitled to become *ex-officio* members of the Society shall, on the recommendation of the Council, be by the Society constituted and declared to be such members.

7. The name of any member of the Society may, on the recommendation of the Council, and by a vote of two-thirds of the members present at a stated meeting of the Society, be dropped from the roll of its members.

CHAPTER IV.

INITIATION FEE AND ANNUAL DUES.

1. The initiation fee, including the dues for the current year, shall be, for a Fellow, ten dollars, to be paid immediately on election.

2. The annual dues thereafter shall be, for a Fellow, ten dollars, to be paid in advance.

3. Any Fellow of the Society, not in arrears, may commute for life all dues for fellowship by the payment at one time, if a Fellow, of one hundred dollars.

4. The name of any Fellow of the Society neglecting for two successive years to pay his annual dues, or at any time wholly refusing to pay them, may by the Council be erased from the list of Fellows of the Society.

5. The fiscal year of the Society shall, for all purposes, be the calendar year; that is, commence on the first day of January, and end with the 31st day of December in each year.

CHAPTER V.

OFFICERS.

1. The officers of the Society shall be a president, three vice-presidents, a foreign corresponding secretary, a domestic corresponding secretary, a recording secretary, a treasurer, and fifteen councilors; and these, together, shall form the Council of the Society.

2. The officers and members of Council elected at the next annual election (except the president and treasurer) shall, at their first meeting, divide themselves into three classes, each to embrace

one vice-president, one secretary, and five members of the Council; one of which classes shall hold office one year, one for two years, and another for three years, to be determined at said meeting by lot or otherwise. The president and treasurer shall always be elected annually; and at each annual election thereafter there shall be elected a vice-president, secretary and five members of Council, each for the term of three years.

3. All officers of the Society to be chosen at any election may be voted for on one ballot.

CHAPTER VI.

ANNUAL MEETING.

1. The annual meeting of the Society shall be held on the second Tuesday after the first day of January in each and every year hereafter, when the annual election of the officers of the Society shall take place; and if, from any cause, there shall be a failure of the annual election at the time above designated for that purpose, the same may be held on the Tuesday next following—that is, on the third Tuesday after the first day of January in each year—and of which due notice shall be given.

2. Every member of the Society, who has been such for twenty days or more, and who is not in arrears for his dues for the past year, shall be entitled to vote at the said election.

3. At the annual meeting of the Society the Council shall present a general report of its proceedings and of those of the Society during the past year, and the secretaries and treasurer shall also present their annual reports.

CHAPTER VII.

MONTHLY AND SPECIAL MEETINGS.

1. The Society, unless otherwise specially ordered by the Society or the Council, shall hold its stated meetings for the transaction of business on the second Tuesday of each month of the year, except July, August and September.

2. The president, or, in his absence, one of the vice-presidents, may, and upon the written request of five members shall, call a

special meeting of the Society by giving three days' notice thereof in two daily newspapers published in the City of New York.

CHAPTER VIII.

ORDER OF BUSINESS.

1. At all stated meetings of the Society for the transaction of ordinary business the order of proceedings shall be as follows:

1. Reading of the Minutes.
2. Reports and Communications from officers of the Society.
3. Reports from the Council.
4. Reports from Committees.
5. Nominations of Members.
6. Special Orders.
7. Unfinished Business.
8. Miscellaneous Business.
9. Papers read and Addresses delivered before the Society.

2. All propositions presented for the action of the Society at any of its meetings shall be in writing, when requested by the presiding officer or any member. A proposition thus presented, when seconded and the question thereon stated from the chair, shall be deemed to be in the possession of the Society and open for discussion, but may be withdrawn by the mover at any time before amendment or decision.

3. No member shall speak more than once upon the same question until all the other members present desiring to speak shall have spoken, nor more than twice on any question without leave of the Society.

CHAPTER IX.

QUORUM.

At all meetings of the Society nine members present shall constitute a quorum for the transaction of business.

CHAPTER X.

COMMITTEES.

All committees authorized by the Society shall, unless otherwise specially ordered, consist of three members each, and be appointed by the presiding officer.

CHAPTER XI.

PRESIDING OFFICER.

At all meetings of the Society, on the arrival of the appointed hour and the presence of a quorum, the president, or in his absence one of the vice-presidents, or in the absence of both a chairman *pro tem.*, shall immediately take the chair, call the meeting to order and preside. He shall have only a casting vote. He shall preserve order and decide all questions of order, subject to an appeal to the Society. He shall also, unless otherwise specially ordered, appoint all committees authorized by the Society; and at every annual election, before the opening of the polls, he shall appoint two tellers of the election.

CHAPTER XII.

SECRETARIES.

1. Foreign Corresponding Secretary.—It shall be the duty of the foreign corresponding secretary to conduct the general correspondence of the Society with individuals and associate bodies in foreign countries.

2. Domestic Corresponding Secretary.—It shall be the duty of the domestic corresponding secretary to conduct the Society's general correspondence with individuals and associate bodies in the United States.

3. Both the foreign and domestic secretaries shall keep, in suitable books to be provided for that purpose, at the Society's rooms, true copies of all letters written by them respectively on behalf of the Society; and shall preserve, on proper files, at the said rooms, all letters received by them on the same account; and at each stated meeting of the Society or the Council, they shall respectively report their correspondence, and read the same, or such parts thereof as may be required.

4. In case of vacancy in the office of either of the corresponding secretaries, or in the absence or disability of either of these officers, the duties of both may be performed by the other corresponding secretary.

5. The Society may designate a particular officer, or appoint a committee to prepare a letter or letters on any special occasion.

6. Recording Secretary.—It shall be the duty of the recording

secretary to give due notice of the time and place of all meetings of the Society, and to attend the same. He shall keep fair and accurate minutes of the proceedings of the Society, and record the same, when approved, in the Society's Journal. He shall give immediate notice to the several officers and committees of the Society, of all votes, orders, resolves and proceedings of the Society affecting them or appertaining to their respective duties. He shall prepare a list of the members of the Society entitled to vote, to be handed to the tellers before the opening of the polls at each annual election. He shall officially sign and affix the corporate seal of the Society to all diplomas and other instruments or documents authorized by the Society or Council. He shall have charge of the corporate seal, charter, by-laws, records and general archives of the Society, except so far as they may be expressly placed under the charge of others. He shall certify all acts and proceedings of the Society, and shall notify the Council of the death, resignation or removal of any officer or member of the Society. He shall have charge of the rooms of the Society, and shall perform all such other and further duties as may from time to time be devolved upon him by the Society or the Council. He, together with the Council, shall have the charge and arrangement of the books, maps and collections belonging to the Society. He shall cause to be kept in the rooms of the Society a registry of all donations to the library or collections of the Society acknowledge their receipt by letter to the donors, and report the same in writing to the Society at its next stated meeting.

7. All documents relating to the Society and under the charge of the secretaries respectively, shall be placed in such depositories in the rooms of the Society as the Council may provide and designate for that purpose.

CHAPTER XIII.

TREASURER.

The Treasurer shall have charge of and safely keep all contracts, certificates of stock, securities and muniments of title belonging to the Society. He shall collect the dues and keep the funds of the Society, and disburse the same under the direction of the Council; and so often as the said funds in the hands of the treasurer shall amount to one hundred dollars, he shall deposit the same, in the

name of the Society, in some incorporated bank in the city of New York, to be designated for that purpose by the Council; and the said funds, thus deposited, shall be drawn out of the said bank on the check of the treasurer, countersigned by the chairman of the Council, and only for the legitimate and authorized purposes of the Society. The treasurer shall, previous to the annual meeting of the Society, prepare and submit to the Council, for audit, a detailed account of his receipts and disbursements for account of the Society during the past year; and which annual account, duly audited, he shall present, with his general report, to the Society at its annual meeting.

CHAPTER XIV.

COUNCIL.

1. The Council shall have the management and control of the affairs, property and funds of the Society, and shall designate an incorporated bank in the city of New York where the said funds shall, from time to time as they accrue, be deposited by the treasurer.

2. It may frame its own by-laws, not inconsistent with the charter or by-laws of the Society.

3. It shall appoint the necessary agents, clerks and servants of the Society, with such powers and duties, privileges and compensation as it may from time to time determine; and may at pleasure revoke such appointments, and make others in their stead.

4. It shall have power to fill, for the unexpired term, any vacancy that may occur in any of the offices of the Society.

5. It shall have power, at its discretion, to declare vacant the seat of any member of its own body (except the president and vice-presidents) who shall have been absent from its meetings for three successive months; and also by a vote of a majority of the whole Council to remove from its own body any member thereof for cause; but in such case it shall be the duty of the Council to report every such vacancy or removal to the Society, at its next stated meeting thereafter, when such cases shall be subject to review by the Society.

6. It shall not, without an approving vote of the Society, at a stated meeting thereof, make any contract whereby a liability in

amount above one thousand dollars may be incurred by the Society; nor without such vote make any sale or disposition of the property of the Society exceeding that sum in value.

7. The Council may, in its discretion, remit the initiation fee or annual dues of any member of the Society.

8. No member of the Council shall receive any salary or pecuniary compensation for his services.

9. The Council shall hold stated meetings for the transaction of business at least once in every month, except the months of July, August and September.

10. At all meetings of the Council, five members present shall constitute a quorum for the transaction of business.

CHAPTER XV.

GENERAL PROVISION AS TO DEBT.

No debt on account of the Society, beyond the funds in the treasury for its payment, shall for any purpose, at any time, be incurred; and if at any time it shall appear that there are resting upon the Society pecuniary obligations beyond the funds in the treasury for their liquidation, no appropriation of funds from the treasury whatever, except for the necessary current expenses of the Society, shall be made, until the said pecuniary obligation shall be fully discharged, or the funds necessary for their extinction shall have been set apart for that purpose.

CHAPTER XVI.

ALTERATION OF THE BY-LAWS.

No alteration in the by-laws of the Society shall be made unless openly proposed at a stated meeting of the Society, entered on the minutes, with the name of the member proposing the same, and adopted by the Society at a subsequent meeting, by a vote of two-thirds of the members present.

CHAPTER XVII.

ADOPTION OF THE BY-LAWS.

The foregoing are hereby adopted and declared to be the by-laws of the Society; and all by-laws of the Society heretofore adopted are hereby rescinded and declared to be null and void.

HONORARY AND CORRESPONDING MEMBERS AND FELLOWS.

HONORARY MEMBERS.

H. I. M. Dom Pedro, Emperor of Brazil.

Constantine, H. I. H., the Grand Duke, President of the Imperial Russian Geographical Society, St. Petersburg.

Dufferin, Right Honorable Frederick Temple Hamilton, Blackwood, Earl of, K P., G.C.M.G., K.C.B., F.R.S., London, England.

Elder, Sir Thomas, Adelaide, South Australia.

Ismail Pacha, H. H., then Khedive of Egypt, Cairo.

Layard, Austin Henry, D.C.L., London, England.

Baker, Sir Samuel White, Pasha, F.R.S., F.R.G.S., London, England.

Markham, Clements R., K.C.B., Secretary Royal Geographical Society, London, England.

McClintock, Sir Admiral Francis Leopold, LL.D., London, England.

Middendorff, Adolph Theodore von, Secretary of the Imperial Academy of Sciences of Russia, St. Petersburg.

Nares, Sir George S., R.N., K.C.B., London, England.

Nordenskjöld, Prof. A. E., Sweden.

Rawlinson, Major-General Sir Henry C., K.C.B., Vice-President Royal Geographical Society, London.

Struve, Professor Otto Wilhelm von, St. Petersburg.

Wilczek, Count H., Vienna.

CORRESPONDING MEMBERS.

Asbjorsen, P. C., Christiania, Sweden.

Abbe, Prof. Cleveland, Washington. D. C.

Alvord, General Benjamin, U. S. Army, Washington, D. C.

Arseniew, Georges, St. Petersburg.

Altamirano, Señor Don Ignacio, Mexico.

Ammen, Rear-Admiral Daniel, U. S. Navy, Washington, D. C.

Balfour, David M., Boston, Mass.

Baker, Commodore F. H., U. S. Navy, Norfolk, Va.

Baranda, Señor Joaquim, Mexico.

Basaraff, Ed. Ivon de, Stuttgart, Würtemberg.

Barclay, James T., M.D., Jerusalem, Syria.

Barnard, Henry, LL.D., Hartford, Conn.

Bartlett, John Russell, Providence, R. I.

Blackie, Walter G., Ph.D., F.R.G.S. Glasgow.

Botassi, Demitri, Consul-General of Greece, New York.

Bastian, Dr. Adolph, Berlin.

BECKER, Prof., M. A., Vienna.
BEHM, Dr. E. Gotha.
BRAINE, Capt. D. L., U. S. N., Washington, D. C.
BREWER, Prof. Wm. H., New Haven, Conn.
BRIGHT, John, M.P., London.
BUSHNELL, Rev. Albert, Gaboon, Equatorial Africa.
CHAIX, Prof. Paul, Geneva.
CHANDLES, W., F.R.G.S., London.
COLLINS, Lieut. Frederick, U. S. Navy. Annapolis, Md.
CHAMBERS, William, LL.D., Edinburgh, Scotland.
DRAPER, Lyman, Madison, Wis.
FRITSCH, Hugo O., New York.
GARDINER, Prof. James T., Director, State Survey, Albany, N. Y.
GILMAN, Prof. Daniel Coit, LL.D., Baltimore, Md.
GUYOT, Prof. Arnold Henry, LL.D., Princeton, N. J.
HAGUE, J. D., New York.
HANCOCK, Prof. Wm. Neilson, LL.D., Dublin.
HAYDEN, Prof. F. V., Washington, D. C.
HOTCHKISS, Major Fred., Staunton, Va.
HITCHCOCK, Prof. C. H., Ph. D., Hanover, N. H.
HOCHSTETTER, Dr. Ferdinand von, Vienna.
HOSMER, Dr. George, New York.
HOUGH, Franklin B., M. D., Washington, D. C.
HUMPHREYS, General A. A., U. S. Army, Washington, D. C.
HUNT, Prof. T. Sterry, LL.D., Boston.
JOHNSTON, W. E., M.D., Paris.
JACKSON, John P., Berlin.
LACROZE, Julis, C.E., Buenos Ayres.
LAMANSKY, Eugene von, St. Petersburg.
LESSEPS, Ferdinand de, Suez, Egypt.
LEFROY, General Sir John Henry, B.A., London, England.
LUCE, Capt. S. B., U. S. Navy, Newport, R. I.
LONG, Col. C. Chaillé, New York.
MCCARTEE, Divie Bethune, M. D., Tokio, Japan.
MALTE-BRUN, V. A., Honorary Secretary of the Geographical Society, Paris.
MARISCAL, Señor Don Ignacio, Mexico.
MARSH, Hon. Geo. P., LL.D., Rome.
MARTIN, Rev. Wm. A. P., President Imperial College, Pekin, China.
MAURY, Louis Ferdinand Alfred, Paris
MAUNOIR, Charles, Paris.
MORGAN, Lewis H., Rochester, N. Y.
MELLO, Dr. T. G. M., Homein de, Rio Janeiro.
MORGAN, Henry Jas., Ottawa, Canada
NAPRSTEK, Vojta, Prague, Austria.
NASSAU, Rev. R. H. Gaboon, Equatorial Africa.
NEGRI, Cristoforo, Turin, Italy.
NEWMARCH, William, Honorary Secretary Statistical Society of London.
ORTIZ, Señor Don Angel D., Seville, Spain.
PASSMORE, Frank B., C. E., New Zealand.
PACKARD, Prof. A. S., Jr., Providence, R. I.
PACHA, Ismail, Governor-General of the Soudan.
POESCHE, Theodore, Washington, D.C.
PARALTA, Señor Don Manuel M., Min. Res. Costa Rica; Washington, D. C.
PUMPELLY, Prof. Raphael, Newport, R. I.
RETIRO, Viscount Bom, President Historical and Geographical Society, Rio Janeiro.
RIMONDI, Don Antonio, Peru.
RAE, John, M.D., London, England.
RAYMOND, Capt. Charles W., U. S. Army, West Point, N. Y.
ROBERTS, Gen. W. M., New York.
ROMERO, Mathias, Mexico.

ROGERS, Rear-Admiral John, U. S. Navy.
ROTHROCK, J.T., M.D., Wilkesbarre, Pa.
ROHLFS, Gerhard, M.D.
SEQURO, Viscount Porto, Minister of Brazil at Vienna.
STONE, Gen. Chas. P., Cairo, Egypt.
SAINT-MARTIN, Vivien de, Paris.
SAPUCACHY, M. le Viscomte, Rio Janeiro, Brazil.
SCHLAGINTWEIT-SAKÜNLÜNSKI, Robt. von, Geissen, Germany.
SCHLAGINTWEIT-SAKÜNLÜNSKI, Hermon von, Munich, Germany.
SCHUMACHER, Herman A., M.D., Consul-General German Empire, New York.
SCHUMACHER, John, Altona, Germany.
SCHUYLER, Eugene, Constantinople.
SELFRIDGE, Com'r T.O., U. S. Navy, Washington, D. C.
SEYMOUR, Horatio, LL.D., Utica, N.Y.
STANLEY, Henry M.
STARRING, Gen. F. A., Paris.
STEVENS, Henry, LL.D., London.
STEERE, J. B., Hong-Kong, China.
VAN BENTHUYSEN, Charles, Albany, N. Y.
VAN CAMPEN, Samuel Richard, London.
WALKER, Gen. Francis A., New Haven, Conn.
WALLING, H. F., C. E., Washington, D. C.
WHEELER, Capt. G. M., U. S. Army, Washington, D. C.
WILLIAMS, S. Wells, LL.D., New Haven, Conn.
WRIGHT, Gen. Horatio G., U. S. Army, Washington, D. C.
WYMAN, Capt. R. H., U. S. Navy, Washington, D. C.
WYSE, Lt.-Com'dr, L. N. B., F.N., Paris, France.
YOUNG, Jess, F.R G.S., Wisbeach, England.

FELLOWS.

CORRECTED TO DECEMBER 31ST, 1879.

Date of Election.
1859 Arnoux, William H.
1859 Arnold, David H. (L. F.)
1859 Aymar, William. (L. F.)
1860 Acton, Thomas C.
1869 Auchmuty, Richard Tylden.
1871 Atterbury, Rev. Wm. Wallace, D.D.
1872 Allen, Horatio M.
1873 Albert, Halpern.
1874 Alexander, Junius B.
1874 Arthur, Gen. Chester A.
1874 Auferman, August.
1874 Auchincloss, Henry B.

Date of Election.
1874 Acker, David D.
1874 Avery, Samuel P.
1874 Amend, Bernhard G.
1874 Ascher, Adolph.
1874 Adams, Rev. Wm., D.D.
1874 Agnew, John T. (L. F.)
1874 Arnold, Richard.
1874 Allen, Henry Wilder.
1874 Amy, Henry.
1874 Agnew, Alexander McL.
1874 Adams, Charles Francis.
1874 Astor, W. W.
1874 Appleton, John A.

1874 Appleton, D. S.
1874 Anderson, Henry H.
1874 Alsop, William.
1875 Amsinck, Gustav.
1876 Andrews, Wm. L.
1876 Appleton, Nathan.
1878 Austin, Charles P.
1879 Austin, William.
1879 Adams, Oliver.
1879 Adams, Mortimer C.
1879 Astoin, Felix.
1879 Agostini, Joseph.
1879 Ashley, Lucius C.
1879 Agnew, Cornelius R., M.D.
1879 Ashley, Lucien S.
1879 Astor, John Jacob. (L. F.)

1852 Bancroft, George. (L. F.)
1852 Barney, Hiram. (L. F.)
1853 Brown, James M.
1853 Butler, Charles.
1856 Baker, Francis. (L. F.)
1856 Berry, Richard.
1856 Brevoort, J. Carson.
1856 Brown, Stewart.
1859 Brown, James. (L. F.)
1859 Boorman, J. Marcus. (L. F.)
1859 Boardman, Andrew.
1859 Bernheimer, Isaac.
1859 Belmont, August. (L. F.)
1859 Barlow, S. L. M.
1860 Benedict, Erastus C.
1861 Butterfield, Gen. Daniel.
1865 Banvard, John. (L. F.)
1865 Bellows, Rev. Henry W., D.D.
1868 Banks, David.
1868 Beckwith, N. M.
1868 Bennett, James Gordon.
1868 Bernheimer, Adolph.
1868 Bernheimer, Simon.
1868 Bill, Edward.
1868 Blake, Charles F.
1868 Brady, John R.
1869 Bailey, Jas. Muhlenberg. (L. F.)
1869 Banyer, Goldsboro.
1869 Bickmore, Prof. A. S.
1869 Bierstadt, Albert.
1870 Butler, Cyrus.
1870 Botta, Prof. Vincenzo.
1870 Body, John E.
1870 Bishop, T. Alston. (L. F.)
1870 Bell, George.
1872 Bryce, James. (L. F.)
1872 Brown, Walston H.
1873 Bailey, N. P.
1874 Bishop, D. W. (L. F.)
1874 Bien, Julius.
1874 Beecher, Rev. Henry Ward.
1874 Bartlett, Willard.
1874 Bissinger, Philip.
1874 Barney, Newcomb C.
1874 Backus, Henry C.
1874 Ballin, Eugene S.
1874 Baldwin, Townsend B.
1874 Bates, Levi M.
1874 Barnes, John S.
1874 Barbour, Thomas (L. F.)
1874 Bonner, Robert.
1874 Bonn, William B.
1874 Bjerring, Rev. Nicolas.
1874 Barnard, Horace.
1874 Barnard, F. A. P., LL.D.
1874 Benjamin, John.
1874 Butler, Wm. Allen.
1874 Bartow, Morey H.
1874 Barling, Henry A.
1874 Barr, William.
1874 Belding, Milo M.
1874 Buckley, Rev. Jas. M.
1874 Bookstaver, Henry W.
1874 Brownson, Lieut. W. H., U.S.N.
1875 Barney, Charles T.
1875 Bancroft, Benjamin F.
1875 Beaman, Charles C., Jr.
1875 Bernheimer, J. A.
1875 Beckwith, Leonard F.
1875 Benjamin, E. B.
1875 Bull, Charles S., M. D.
1875 Beekman, Gerard.
1875 Babcock, Gen. O. E., U.S.Army.
1875 Brownell, Silas B.
1875 Bergland, Lt. Eric, U.S. Army.
1875 Burgess, William J.
1875 Brown, Vernon H.

1875 Barnes, William.
1875 Beste, Henry.
1875 Bredt, Ernest.
1875 Bernacki, Charles, M.D.
1875 Bent, Captain Silas.
1875 Bedle, Joseph D.
1875 Belknap, Capt. Geo. E., U.S.N.
1875 Bowie, Augustus J., Jr.
1876 Bowne, Richard H.
1876 Burnett, Henry L.
1876 Buell, James.
1876 Banks, James L., M.D.
1876 Baldwin, Commodore Charles H., U.S.N.
1876 Brower, John.
1876 Billings, Frederick.
1876 Bellew, F. H. T.
1877 Booth, George.
1877 Bixby, Robert F.
1877 Börs, Christian.
1877 Briggs, Prof. Charles A.
1877 Blanchard, George R.
1877 Blatchford, Eliphalet W.
1878 Brodhead, Richard.
1878 Bliss, Cornelius N.
1878 Brown, G. Melville.
1878 Barton, Oliver Grant. (L. F.)
1878 Brown, Rev. Philip A. H.
1878 Brand, James.
1878 Brown, J. Warren.
1878 Brown, J. Romaine.
1879 Brady, James T.
1879 Babcock, Henry C.
1879 Bronson, Theodore B.
1879 Barattoni, C. A.
1879 Bowen, Gen. Edmund S.

1852 Colton, Joseph H. (L. F.)
1855 Conkling, Frederick A. (L. F.)
1855 Cooper, Peter.
1856 Cooley, James E. (L. F.)
1856 Colgate, Charles C.
1856 Cooper, Edward.
1856 Crooks, Ramsey. (L. F.)
1856 Curtis, Wm. E.
1862 Cowdin, Eliot C.
1863 Cary, William F. (L F.)
1868 Catlin, N. W. Stuyvesant (L.F.)
1868 Cisco. John J.
1868 Chapman, Joseph H.
1869 Cullum, Gen. George W., U. S. Army. (L. F.)
1870 Conklin, William A.
1872 Corse, Israel.
1872 Conklin, Eugene E.
1872 Crawford, Gen. S. W., U. S. Army.
1872 Clark, E. V.
1872 Cox, Samuel S.
1873 Coster, Charles H.
1874 Cruickshank, James, LL.D.
1874 Connery, T. B.
1874 Cowdrey, N. A.
1874 Curphey, James.
1874 Campbell, Allan.
1874 Church, Col. George E.
1874 Chistern, F. W.
1874 Courtright, Milton.
1874 Cockcroft, Jacob H. V.
1874 Chickering, Charles F.
1874 Comstock, Cornelius.
1874 Constable, James M.
1874 Ceballos, J. M.
1874 Carter, Walter S.
1874 Caswell, Wm. H.
1874 Crerar, John.
1874 Crocker, David.
1874 Cruikshank, Edwin A.
1874 Crosby, J. Schuyler.
1874 Clark, Lot Curran.
1874 Coates, Isaac T., M.D.
1874 Cochrane, Capt. Henry Clay, U.S.M.C.
1874 Colgate, James B.
1874 Constantine, Andrew J.
1874 Constantine, John.
1874 Corning, Erastus.
1874 Cottenet, Francis.
1874 Cossitt, Frederick H.
1874 Coutan, Charles E.
1874 Conyngham, Wm. L.
1874 Crosby, Hiram B.

1874 Crocker, Geo. A.
1874 Crocker, Wm. Baylies.
1874 Chickering, George H.
1874 Carter, Oliver S.
1874 Carhart, Thos. F.
1874 Catlin, Julius, Jr.
1874 Cabot, Stephen.
1874 Colgate, Robert.
1874 Curren, Robert.
1875 Clendenin, J. W.
1875 Cameron, R. W.
1875 Cushman, W. F.
1875 Colgate, Bowles.
1875 Cooper, George C.
1875 Champlin, John D., Jr.
1875 Cassebeer, Henry A., Jr.
1875 Childs, Calvin G.
1875 Cone, James B.
1875 Chittenden, S. B., Jr.
1876 Clarke, W. H.
1876 Cullum, Mrs. George W. (L. F.)
1876 Constable, Major A. G.
1876 Cornell, John B.
1876 Curtis, Benj. L.
1876 Curtis, Benjamin R.
1878 Cornwallis, K.
1878 Chisholm, Alexander Robert.
1879 Cooper, James G.
1879 Church, Simeon E.
1879 Clark, G. W. C.
1879 Caldwell, Towson.
1879 Coddington, Gilbert S.
1879 Caldwell, R. A., M. D.
1879 Childs, George W.

1855 Daly, Chief-Justice C. P. (L. F.)
1855 Dunshee, Prof. Henry W.
1856 Douglas, Andrew E.
1856 Dodge, Wm. E.
1856 Dodge, Wm. E., Jr.
1856 Detmold, Wm., M.D.
1859 Dickerson, E. N.
1864 Detmold, Christian E.
1866 Darling, Wm. A.
1868 Dwight, Prof. Theo. W.
1868 Du Chaillu, Paul B.
1868 Dennis, Charles. (L. F.)
1868 Davies, Henry E.
1870 Dash, John B.
1870 Davies, Alexander J. (L. F.)
1870 Drowne, Henry T.
1870 Dinsmore, William B.
1871 Daly, Joseph F.
1873 De Peyster, Frederick. (L. F.)
1873 Delano, Franklin H.
1873 Dwight, James F.
1874 De Peyster, Gen. J. Watts. (L.F.)
1874 Diefendorf, Menzo.
1874 Davis, Noah.
1874 Dillon, Romaine. (L. F.)
1874 Dutilh, E.
1874 Downer, Samuel.
1874 Decker, Charles A.
1874 Delafield, M. L.
1874 Dana, Charles A.
1874 Draper, Frank E.
1874 Devlin, Jeremiah.
1874 Davidson, Stratford P.
1874 Donohue, Charles.
1874 Decker, John J.
1874 Del Monte, Leonardo.
1874 Du Bois, Wm. A.
1874 De Castro, Diego.
1874 Delmonico, L.
1874 Davis, John G.
1874 Davis, John H.
1874 Dalrymple, Alexander.
1874 Duke, John H.
1874 Dunscomb, Richard T.
1874 Dun, R. G.
1874 Defendorf, Wilson.
1875 Darrow, William.
1875 Davies, Julien T.
1875 Du Bois, Eugene.
1875 Donnelly, John J.
1875 Daniel, Edwin M.
1875 Dodd, Josiah F.
1875 Davidson, Charles A.
1875 De Peyster, Frederic J. (L. F.)
1875 Delafield, Lewis L.
1875 Dommerick, L. F.
1876 Davis, Gilbert F.

1876 Day, Lieut. Murray S., U.S.N.
1876 Drexel, Joseph W.
1877 Day, Henry M.
1877 Davis, Joseph Beale. (L. F.)
1877 Dorsheimer, William.
1878 Dana, Charles.
1878 Day, Gen. H., U.S. Army.
1878 Di Cesnola, Gen. L. B.
1879 Dahlgren, Charles B.
1879 Dodge, George E.
1879 Delavan, Edward C.
1879 Dana, Samuel B.

1853 Eyre, Henry S. P.
1859 Evarts, William M.
1864 Evans, Walton W.
1868 Emmet, Thomas Addis, M.D.
1872 Edwards, Jonathan.
1874 Ernst, C. W.
1874 Eaton, Dorman B.
1874 Eaton, D. Cady.
1874 Ewen, John, Jr.
1875 Eldridge, Titus B.
1875 Esterbrook, Richard, Jr.
1875 Ellis, John W.
1875 Elliott, John.
1875 Eimer, Charles.
1875 Ely, Richard S.
1875 Eads, Captain James B., C.E.
1876 Ellers, George Howard.
1877 Elderkin, John.
1878 Eno, John C.
1878 Ellis, John, M.D.
1878 Edson, Franklin.
1879 Everett, William.
1879 Earl, Ferdinand P.
1879 Elliott, Samuel.

1854 Field, Cyrus W. (L. F.)
1856 Field, David Dudley.
1856 Field, B. H. (L. F.)
1857 Fish, Hamilton.
1859 Fogg, Wm. H. (L. F.)
1860 Field, Rev. H. M.
1864 Faile, Thomas H.
1868 Frohwein, Theobald.
1869 Furniss, William.
1869 Forsyth, Rev. John.
1869 Field, Dudley.
1871 Fliess, Wm. M.
1873 Freedman, John J.
1873 Fithian, Freeman J.
1874 Farragut, Loyall.
1874 Foshay, James W.
1874 Fabbri, Egisto P.
1874 Fellows, John P.
1874 Francklyn, C. G.
1874 Fleet, Oliver S.
1874 Fatman, Lewis.
1874 Fabbri, Ernesto G.
1874 Foster, Wm. R.
1874 Forman, Alexander.
1874 Fox, Baldwin N.
1874 Frothingham, Rev. O. B.
1874 Fougera, Edmund C.
1874 Frame, Charles P.
1874 Fox, Austen G.
1875 Foulke, Thomas.
1875 Faile, Charles V.
1875 Fargo, James C.
1875 Fuller, Charles D.
1875 Farquhar, Col. Francis U., U. S. Army.
1875 Forster, Robert.
1875 Ford, James B.
1875 Foote, Emerson.
1875 Fay, A. Goodrich.
1875 Folsom, George W.
1876 Fisk, Gen. Clinton B.
1877 Fiske, Andrew.
1877 Flagg, William J.
1878 Ferris, L. Murray, Jr.
1878 Fales, William E. S.
1879 Fellows, John R.
1879 Ferris, Robert M.

1856 Greenwood, Isaac J.
1856 Guernsey, Egbert, M.D.
1857 Greene, John W., M.D (L. F.)
1859 Griswold, George. (L. F.)
1860 Graham, James L. (L. F.)
1868 Gambrill, C. D.

1868 Gebhard, Wm. H. (L. F.)
1868 Gerry, Elbridge T. (L. F.)
1868 Green, Andrew H.
1868 Greene, Gen. G. S.
1869 Gilbert, Clinton.
1870 Graham, Gen. C. K.
1872 Gerard, James W.
1872 Grinnell, R. M. (L. F.)
1873 Gillmore, Gen. Q. A., U.S.A.
1873 Gedney, Frederick G.
1873 Glaubensklee, Theo. G.
1874 Gardner, Hugh.
1874 Green, John.
1874 Gunther, William Henry.
1874 Gunther, F. F.
1874 Gibert, Fred. E.
1874 Gibbs, Theodore K.
1874 Gottsberger, William S.
1874 Goodsell, James H.
1874 Gomez, Raphael M.
1874 Galpen, Horace.
1875 Greene, Lieut. F. V., U.S.A.
1875 Gordon, Robert.
1875 Germond, Wellington.
1875 Greene, G. S., Jr., C.E.
1875 Garrison, Cornelius K.
1875 Gibson, James.
1875 Goepp, Charles.
1876 Gautier, Dudley G.
1877 Gaylord, Augustus.
1877 Guleke, H. F., M.D.
1878 Gescheidt, Mrs. A.
1878 Gillies, James W.
1878 Garrison, William R.
1879 Graves, Arthur B.
1879 Gebhard, Edward.
1879 Gay, Joseph E.

1856 Hewitt, Abram S.
1856 Hunt, Wilson G.
1856 Herring, Silas C.
1858 Holton, David P., M.D. (L. F.)
1859 Henderson, John C.
1859 Havemeyer, John C. (L. F.)
1864 Hammond, Henry B.
1868 Huntington, Daniel. (L. F.)
1868 Hurlbert, William H.
1868 Hoyt, David.
1868 Hoguet, Robert J.
1868 Hall, Elial F.
1868 Hayes, Isaac I., M.D.
1868 Hadden, John A. (L. F.)
1868 Hallock, Mrs. Frances.
1869 Hutchins, Waldo.
1870 Hawkes, Prof. W. Wright.
1870 Havens, Charles G.
1870 Harrison, Prof. Thomas F.
1871 Hamilton, Alexander, Jr.
1871 Hand, Clifford A.
1872 Hoffman, William B.
1872 Hammersley, John W. (L. F.)
1872 Hawkins, Dexter A.
1872 Holbrook, Levi.
1873 Havemeyer, Theo. A.
1874 Hamersley, A. Gordon. (L. F.)
1874 Hamersley, Louis C. (L. F.)
1874 Hancock, Gen. Winfield S., U.S.A.
1874 Hay, John.
1874 Haldeman, S. S.
1874 Hitchcock, Rev. Roswell D., D.D.
1874 Havemeyer, Hector C.
1874 Hoguet, Henry L.
1874 Hoyt, Oliver.
1874 Hurlbert, Henry A. (L. F)
1874 Hutton, Benjamin H.
1874 Haydock, George G.
1874 Haines, John P.
1874 Hinton, John H., M.D. (L. F.)
1874 Hendricks, M. M.
1874 Hawk, Samuel.
1874 Hallgarten, Adolphus.
1874 Havemeyer, James.
1874 Holbrook, E. F.
1874 Hoe, Richard M.
1874 Harper, Nathan.
1874 Hunter, Charles F.
1874 Hendricks, Edmund.
1874 Hendricks, Joshua.
1874 Hawes, James W.
1874 Hatch, Rufus.
1874 Huntington, C. P.
1874 Hunter, Lieut. Edward, U.S.A.

1874 Hoyt, Harlow M.
1875 Hubbard, Prof. O. P.
1875 Howard, Thomas T., Jr.
1875 Hammond, Wm. A., M.D.
1875 Houston, Col. D. C., U.S.A.
1875 Heuer, Capt. Wm. H., U.S.A.
1875 Howell, Maj. Charles W., U.S.A.
1875 Hoadley, John C.
1875 Hughes, Wm. H. T.
1875 Hoppenstedt, G. L.
1875 Hauemann, John F.
1875 Howland, Meredith.
1875 Hyde, Henry B.
1875 Harper, P. J. A.
1875 Hazen, Gen. W. B., U.S. Army.
1875 Harris, Siegmund.
1875 Hun, Leonard G.
1876 Heminway, Albert G.
1876 Holt, Henry.
1876 Hallock, Henry W.
1876 Halsted, Major Geo. B.
1876 Hoare, W. Robert.
1876 Holman, Frank E.
1876 Hyde, Samuel N.
1876 Hoes, Wm. M.
1876 Hatfield, J. B. T.
1877 Houghton, Prof. Walter R.
1878 Howe, George S.
1878 Hermann, Henry.
1878 Hinman, Wm. K.
1878 Holden, Horace.
1878 Hitchcock, Hiram
1879 Hamilton, William G.
1879 Harris, Col. Robert.
1879 Hodges, George.
1879 Hayes, A. A., Jr.
1879 Hamilton, Capt. F. B., U.S.A.

1859 Ireland, John B.
1874 Isaacs, Isaac S.
1874 Ives, Fred'k E.
1874 Iselin, Adrian, Jr.
1879 Inman, William H.
1879 Isham, Charles H.

1852 Jay, John. (L. F.)
1852 Jones, John D. (L. F.)
1868 Johnson, Henry W.
1868 Johnson, Hezron A.
1870 James, Fred'k P.
1871 Jones, Walter R. T.
1874 Judson, Wm. D.
1874 Janssen, Gerhard.
1874 Jesup, M. K.
1874 Jaffray, Edward S.
1874 Jenkins, Wm. L.
1874 James, D. Willis.
1874 Jameson, Joseph A.
1874 Jordan, Conrad N.
1874 Jones, George.
1874 Jaffray, Robert.
1876 Johnston, James W.
1876 Jones, John M.
1878 Jones, George H.
1878 Judson, Capt. J. A., C.E.
1879 Jay, William.

1854 Kennedy, Robert Lenox.
1869 Kelly, Eugene.
1870 Kühne, Frederick.
1872 Kendrick, Col. H. L., U.S. Army.
1873 Kennan, George.
1874 King, Edward.
1874 Kearney, Joseph R.
1874 Kunhardt, Henry R.
1874 Kingsland, Wm. M. (L. F.)
1874 Kidder, Henry P.
1874 Kalbfleisch, Charles H.
1874 Knoedler, Julius.
1874 Keck, Thomas.
1874 Kemp, William.
1874 Knower, John.
1874 Kemp, John H.
1874 King, David, Jr.
1874 King, Lewis.
1875 Knapp, Herman, M.D.
1876 Knauth, Percival.
1877 King, Clarence.
1877 Kane, Gen. Thomas L.
1878 Kernochan, Jas. Lorillard. (L. F.)
1879 Kane, S. Nicholson.

1852 Livingston, Cambridge. (L. F.)
1857 Low, A. A.
1859 Lenox, James.
1859 Lathers, Richard. (L. F.)
1868 Lawrence, Abraham R.
1869 Lawrence, John S. (L. F.)
1870 Loew, Frederick W.
1870 Lyman, Edward H. R.
1871 Letson, Robert S
1871 Larremore, Richard L.
1871 Lee, Ambrose.
1872 Libbey, William. (L. F.)
1873 Lydig, Mrs. P. M.
1874 Lathrop, F. S. (L. F.)
1874 Lauterbach, Edward.
1874 Livingston, Robert J. (L. F.)
1874 Langdon, Walter. (L. F.)
1874 Lorillard, Peter.
1874 Lord, George W. T.
1874 Lorillard, George L.
1874 Leavenworth, E. W.
1874 Livingston, John A.
1874 Livingston, Robert E.
1874 Littlejohn, James.
1874 Lawton, Walter E.
1874 Lawrence, Jos. B.
1874 Leggett, Francis W.
1874 Le Comte, Joseph.
1874 Lewis, Walter H.
1874 Lawson, Leonidas M.
1874 Lane, George W.
1874 Lawrence, Samuel B.
1874 Lawrence, Alexander C.
1874 Lawrence, Effingham N.
1874 Lesher, Stephen R.
1875 Luff, George.
1875 Low, Seth.
1875 Lawrence, George N.
1876 Low, A. Augustus.
1876 Lindau, Leopold.
1877 Lockwood, Le Grand.
1877 Lindley, John.
1877 Latrobe, John H. B.
1878 Loubat, J. F., LL.D. (L. F.)
1878 Leon, Nestor Ponce de
1879 Levy, Augustus H.

1852 Myers, Col. T. Bailey. (L. F.)
1853 Moore, George H. (L. F.)
1856 Morgan, E. D.
1856 Monroe, Ebenezer.
1856 Manners, David S.
1859 MacMullen, John.
1859 Morrell, Wm. H. (L. F.)
1859 Moore, Frank. (L. F.)
1863 May, Lewis.
1863 Moore, W. H. H. (L. F.)
1864 Morton, Levi P.
1866 Morris, Robert R.
1868 Morrison, Henry.
1868 Moreau, John B.
1868 Montgomery, A. G., Jr.
1868 Martin, Isaac P.
1868 Marquand, Henry G.
1868 Marsh, Luther R.
1868 MacKellar, William.
1868 McClure, George.
1869 Mount, Richard E. (L. F.)
1869 Moore, Henderson.
1870 Marbury, Francis F.
1870 Myer, Gen. A. J., U. S. A. (L. F.)
1870 Murray, D. Colden.
1870 Miles, Edward D.
1872 Myer, F. William.
1872 Matthews, Edward. (L. F.)
1872 Marié, Peter. (L. F.)
1873 Moore, C. B.
1874 Morris, Henry L.
1874 Mailler, W. H.
1874 Macy, William H.
1874 Marble, Manton.
1874 Morrison, Edward.
1874 Morgan, W. F.
1874 Montgomery, Thomas H.
1874 Miller, Philip S.
1874 McElligott, Henry R.
1874 Mott, Alexander B., M.D.
1874 Moir, James.
1874 Morgan, J. Pierpont. (L. F.)
1874 Maclay, Isaac W., C.E.
1874 Myers, John K.
1874 Martin, John M.
1874 McAlpin, David H.
1874 Merrall, William J.
1874 McMahon, Gen. M. T.

1874 Moulton, Clarence F.
1874 Miller, Geo. Macculloch.
1875 Marshall, F. Pelham.
1875 Mitchell, Edward.
1875 Macy, Arthur.
1875 Marcus, Arnold.
1875 Meyer, Theo. F. H.
1875 Mott, Henry A., Jr.
1875 Michler, Gen. Nathaniel, U.S.A.
1875 Monheimer, Joseph A.
1875 Magoun, George C.
1875 Maclay, Moses B.
1875 Martin, Bradley.
1875 Meyer, L. H.
1875 McLanahan, Geo. William.
1876 Mitchell, W. Howard.
1876 Mitchell, Edwin P.
1876 Mattson, Morris, M.D.
1877 Morton, Wm. J., M.D.
1877 Matsell, George W.
1878 Morison, John C.
1878 Merrick, William H.
1878 Montant, Alphonse.
1878 Motley, James.
1878 Musgrave, Thomas B.
1878 Mason, Lieut. T. B. M., U.S.N. (L. F.)
1879 Marshall, William I.
1879 Mather, Frederick E.
1879 Motz, Ferdinand.
1879 Miller, John Bleecker.
1879 Monteith, James.

1859 Norrie, Adam. (L. F.)
1870 Neilson, William H.
1873 Neilson, Frederic.
1874 Nourse, Prof. J. E.
1874 Newell, John.
1874 Neergaard, Wm.
1874 Niles, William W.
1874 Nones, Alexander.
1874 Newcombe, Isaac B.
1875 Newton, Gen. John, U. S. Army.
1875 Northrop, A. L.

1868 Ogden, Alfred.
1869 O'Conor, Charles.
1874 Ottendorfer, Oswald.
1874 Osgood, Franklin.
1874 Olyphant, Robert M.
1874 Oakley, E. Benedict.
1874 Owen, Frederick N.
1875 Otterbourg, Marcus.
1875 Ottiwell, John D.
1875 O'Connor, Thomas H.
1875 Opdyke, William S.
1876 Olmsted, Fred'k Law.
1876 Olmstead, Dwight H.
1877 O'Gorman, Richard.
1877 Ogden, Isaac C., Jr.
1878 Osgood, Prof. Howard.
1879 Osborn, Henry F.
1879 O'Gorman, Richard, Jr.
1879 O'Brien, Thomas.

1852 Prime, Frederick. (L. F.)
1852 Poor, Henry V. (L. F.)
1852 Pierrepont, Henry E. (L. F.)
1855 Pierrepont, Edwards.
1857 Pyne, Percy R.
1859 Purser, George H.
1859 Prime, Fred'k E. (L. F.)
1860 Phelps, Royal. (L. F.)
1862 Phillips, George W.
1868 Powers, William P.
1868 Paulison, John P.
1868 Parton, James.
1871 Potter, Howard.
1871 Peabody, Charles A.
1872 Parish, Henry.
1873 Plum, Elias.
1874 Parker, Willard, M.D.
1874 Peake, William I.
1874 Peckham, Walton H.
1874 Peabody, Arthur J.
1874 Penfold, William Hall.
1874 Phelps, I. N.
1874 Phoenix, S. Whitney. (L. F.)
1874 Potter, Orlando B.
1874 Pondir, John.
1874 Popham, William H.
1874 Parsons, George W.
1874 Paris, Sherman.

1874 Pastor, Henry.
1874 Preble, John Q.
1874 Porter, John K.
1874 Packer, Elisha A.
1874 Powers, George J.
1874 Pellew, Henry E.
1874 Prichard, William M.
1875 Prentice, W. P.
1875 Pope, Gen. John, U. S. Army.
1875 Pfund, Anton.
1875 Peipers, Hugo.
1875 Porter, Gen. Horace.
1876 Perkins, George W.
1876 Parsons, Levi.
1876 Peet, William E.
1876 Plum, James R.
1876 Palmer, Gen. W. J.
1877 Prime, Rev. Wendell, D.D.
1878 Parsons, Arthur W.
1878 Parsons, Edwin.
1878 Prescott, George B.
1879 Peck, Prof. Myron Griffin.

1854 Ruggles, Samuel B.
1854 Rutherford, L. M.
1856 Randolph, Anson D. F.
1856 Remsen, William. (L. F.)
1856 Riker, John H.
1859 Rapallo, Charles A.
1859 Reckendorfer, Joseph. (L. F.)
1861 Rogers, C. B. (L. F.)
1868 Raven, Anton A.
1868 Roberts, Marshall O.
1868 Rose, Cornelius.
1872 Robbins, Chandler. (L. F.)
1873 Reinhart, B. F. (L. F.)
1874 Reid, Whitelaw.
1874 Rives, Francis R.
1874 Richard, Auguste.
1874 Ruggles, Philo T.
1874 Rogers, H. Livingston.
1874 Riley, Charles V.
1874 Riker, William J.
1874 Requa, James M.
1874 Reynes, Jaime.
1874 Renauld, Peter A. H.
1874 Richard, Charles B.
1874 Rhoades, John H.
1874 Ramsey, Charles G.
1874 Ransom. F. A.
1874 Rhoades, Lyman.
1875 Roosevelt, Clinton.
1875 Robinson, Henry E.
1875 Rives, G. L.
1875 Roberts, Nathan B.
1875 Read, J. Meredith.
1875 Ranft, Richard.
1875 Raht, Edward E.
1875 Rose, Charles.
1875 Rosenfeld, Isaac.
1876 Ross, William B.
1877 Rose, Theodore.
1877 Rice, A. Thorndike.
1877 Roome, William P.
1878 Rogers, Charles H.
1878 Roorback, Orville A.
1878 Rainey, Thomas, M.D.
1878 Robinson, Thomas H.
1879 Redmond, James Morton.
1879 Rhinelander, Miss J. (L. F.)

1853 Smith, James O., M.D.
1854 Sewell, Henry F.
1855 Stuart, Robert L.
1856 Stebbins, Henry G.
1856 Spofford, Paul N.
1856 Schermerhorn, Wm. C.
1856 Sherman, W. Watts.
1859 Schell, Augustus. (L. F.)
1859 Schultz, John H. (L. F.)
1860 Stout, Francis A. (L. F.)
1868 Seward, Clarence A.
1868 Shea, George.
1869 Savage, John. (L. F.)
1869 Strebeigh, Robert M.
1870 Schell, Richard. (L. F.)
1870 Sherwood, John.
1870 Sistare, George K.
1870 Schafer, Samuel M.
1870 Schafer, Simon.
1870 Seligman, Joseph.
1870 Seligman, James.

1870 Seligman, Jesse.
1870 Stoughton, Charles B.
1871 Shaler, Gen. Alexander.
1871 Swan, William H.
1872 Stern, Myer.
1872 Stengel, Prof. Frederick.
1872 Steiger, E.
1872 Stuyvesant, Rutherfurd. (L. F.)
1873 Smith, James M.
1873 Slevin, Thomas E.
1873 Sturges, Frederick.
1873 Spencer, James C.
1873 Strong, Charles E.
1873 Scott, Julian. (L. F.)
1873 Southworth, Alvan S. (L. F.)
1873 Sturgis, Frank K.
1874 Stone, Henry.
1874 Sands, Harry M.
1874 Steinway, William.
1874 Storrs, Charles. (L. F.)
1874 Sands, Philip J.
1874 Smith, Samuel Drake.
1874 Squires, Robert.
1874 Sloan, Samuel.
1874 Schermerhorn, F. Augustus.
1874 Stuyvesant, Robert R.
1874 Scott, Col. Henry L.
1874 Scudder, Henry J.
1874 Stuart, Joseph.
1874 Swarr, David M.
1874 Stokes, James.
1874 Strong, W. L.
1874 Steward, D. Jackson.
1874 Stevens, Alexander Henry.
1874 Sherman, Benjamin B.
1874 Shethar, Samuel.
1874 Sheafe, J. F.
1874 Schieffelin, Samuel B.
1874 Scott, Thomas A.
1874 Stiger, William E.
1874 Stillwell, Benjamin M.
1874 Sawyer, Warren.
1874 Sands, Andrew H.
1874 Schaus, William.
1874 Simpkins, N. S., Jr.
1874 Spinney, Joseph S.
1874 Salomon, Edward.
1874 Sewell, Robert.
1874 Striker, J. A.
1875 Stanford, William H.
1875 Smith, Lewis Bayard.
1875 Smith, Charles Stewart.
1875 Stewart, Col. Charles S., U S.A.
1875 Sturges, Henry C.
1875 Schultz, Carl H.
1875 Stone, Charles Francis.
1875 Sandford, Elliott. (L. F.)
1875 Stranahan, J. S. T.
1875 Schofield, Gen. John M., U.S.A.
1875 Schieffelin, H. Maunsell.
1875 Schack, Fred.
1875 Sherman, Isaac.
1875 Sibley, Gen. Henry H., U.S.A.
1875 Schiff, Jacob H.
1875 Strazburger, Oscar.
1875 Schlesinger, Alfred.
1875 Smith, Apollos.
1875 Smith, Augustine.
1876 Schem, Prof. Alexander J.
1876 Smith, Harsen H.
1876 Sibley, Hiram W.
1876 Spaulding, Henry F.
1876 Smith, Dwight, M.D.
1876 Stryker, Gen. William S.
1876 Stone, A. B.
1877 Schuyler, Philip
1877 Shearman, William P.
1877 Sanford, Henry S.
1877 Sanger, Major Joseph P., U.S.A.
1877 Schaff, Rev. Philip, D.D.
1878 Scott, James.
1878 Scott, Thomas.
1878 Stewart, William Rhinelander.
1878 Slocum, J. J.
1878 Sanford, A. Wright.
1878 Swayne, Judge Noah H.
1878 Sands, William R.
1878 Smith, S. Newton.
1878 Smull, W. P.
1878 Sabla, Theodore de Joly de.
1879 Saltus, Edgar Evertson.
1879 Simion, Leonhard.

1879 Smith, Herbert H.
1879 Stone, R. C.
1879 Speir, Francis, Jr.
1879 Stevens, Frederick W. (L. F.)
1879 Smith, E. Reuel.
1879 Shields, Prof. Charles W.
1879 Stetson, Francis Lynde.
1879 Squires, Grant.
1879 Spencer, Mrs. Catherine L. (L.F.)

1855 Tellkampf, T. A., M.D.
1856 Tiffany, Charles L.
1856 Townsend, Randolph W.
1859 Tracy, Charles.
1868 Taylor, Douglas.
1868 Tilden, Samuel J.
1870 Tuckerman, Lucius.
1870 Thomson, James.
1872 Tower, Gen. Z. B., U. S. Army.
1872 Tracy, William.
1872 Tyler, Arthur W.
1874 Thompson, David G. (L. F.)
1874 Tiemann, Peter C.
1874 Tefft, Erastus T.
1874 Thorne, Jonathan.
1874 Tousey, Sinclair.
1874 Trevor, John B.
1874 Taylor, Alfred J.
1874 Thorne, William H.
1874 Turner, Herbert B.
1874 Terry, Com'r Edward, U.S.N.
1875 Taintor, Charles M.
1875 Thurber, Francis B.
1875 Terry, Gen. Alfred H., U.S. Army.
1875 Toel, William.
1875 Terbell, Henry S.
1876 Tappan, J. Nelson.
1876 Trenchard, Edward.
1876 Totten, Lieut. George Mansfield, U. S. Navy.
1876 Terry, Rev. Roderick.
1877 Thomas, T. Gaillard, M.D.
1877 Tillinghast, William H.
1877 Talcott, James. (L. F.)
1877 Tucker, Rev. William J., D.D.
1878 Taylor, Rev. Wm. M., D.D.
1879 Thompson, J. P.
1879 Turnbull, Robert J.

1876 Uhl, Herman.

1854 Viele, Gen. Egbert L.
1868 Van Santvoord, C.
1869 Vanderpoel, Aaron J.
1870 Van Brunt, Charles H.
1874 Voorhis, William.
1874 Vanderbilt, William H.
1874 Vincent, Frank, Jr.
1874 Vyse, Thomas A., Jr.
1874 Van Volkenburgh, P.
1874 Van Rensselaer, K.
1874 Vail, Henry F.
1875 Vance, Samuel B. H.
1875 Van Buren, John D., Jr.
1875 Valentine, Lawson.
1875 Von Post, H. C.
1875 Vanderpoel, A. Ernest.
1875 Verhuven, Henry F.
1875 Von Dorrien, S.
1876 Van Hoesen, George M.
1876 Van Brunt, Cornelius.
1877 Vanderbilt, Cornelius.
1877 Voorhees, Charles H.
1878 Vanderbilt, William K. (L. F.)
1878 Voorhis, John R.
1879 Vilas, Royal C.

1854 Webb, William H.
1854 Wetmore, Samuel. (L. F.)
1854 Witthaus, G. H. (L. F.)
1856 Westermann, B.
1859 Ward, George Cabot. (L. F.)
1860 Winston, Frederick S.
1866 Wendell, Jacob.
1868 White, Alexander M.
1869 Ward, Gen. Elijah.
1869 Weber, Leonard, M.D.
1870 Webster, Sidney.
1870 Wilson, Gen. James Grant. (L.F.)
1870 Wright, E. Kellogg.
1870 Weston, Theodore, C.E.
1870 Ward, T. W.

1872 Wetmore, Wm. Boerum. (L. F.)
1872 Williams, Stephen C. (L. F.)
1872 Wells, Jacob.
1873 Weiner, Joseph, M.D. (L. F.)
1873 Worthen, Wm. E., C.E.
1874 Weyman, Charles S.
1874 White, Lt.-Com. H. C., U.S.N.
1874 Waite, Chief Justice M. R.
1874 Wheeler, Everitt P.
1874 Wadsworth, Julius.
1874 Wallack, J. Lester.
1874 Wetmore, George P. (L. F.)
1874 Wales, Salem H.
1874 Willets, Samuel.
1874 Wyckoff, Jacob F.
1874 Williamson, David B.
1874 Wilder, Marshall P.
1884 Wilkeson, Samuel.
1874 Worth, James L.
1874 Waite, Charles C.
1874 Walraven, Ira E.
1874 Wooster, George H.
1875 Work, J. Henry.
1875 Wheeler, John V.
1875 Willard, Lieut. J. H., U.S.A.
1875 White, Charles Trumbull.
1875 Wilson, Gen. J. H.
1875 Wilcox, Franklin A.
1875 Wilkes, George.
1875 Warner, Lewis T., M.D.
1875 Windmuller, Louis.
1875 White, David, C.E.
1875 Winslow, Gen. Edward F.
1875 Williams, Gen. George B.
1875 Waller, Prof. Elwyn.
1875 Whitehead, Com'r Wm., U.S.N.
1875 White, Loomis L.
1875 Whipple, Lieut. C. W., U.S.A.
1875 Wissman, J. F.
1876 Ward, Roswell B.
1876 Walker, Evan T.
1876 Wedemeyer, A. J. D.
1876 Wrigley, Henry E., C.E.
1877 Ward, W. S.
1877 Waters, James T.
1877 Woodruff, Col. D., U.S.A.
1878 Whitehead, Henry M.
1878 Witherbee, S. H.
1878 Wells, John W.
1878 Wood, Isaac F.
1878 Watson, William.
1878 Whittemore, Charles.
1878 Whittemore, Thomas W.
1879 Williams, Richard P.
1879 Watson, Francis A. (L. F.)
1879 Woodbury, Charles H.
1879 Wirths, Maurice.
1879 Wilcoxson, George.
1879 Wolfe, Miss Catherine. (L. F.)

1871 Youngs, Henry I.
1874 Young, Mason.
1875 Yoshidi, Kiyonari.
1879 Yates, Ellis Samuel.

1874 Zachos, Prof. J. C.
1875 Zollikoffer, Oscar.

FELLOWS DECEASED, 1879.

1876 Amory, Copley.
1875 Brewerton, Gen. Henry, U.S.A.
1874 Cushing, Caleb.
1874 Cogswell, William L.
1874 Dix, Gen. John A.
1875 Hodgskin, James B.
1868 Leslie, Frank.
1874 McCurdy, Robert H.
1874 Norwood, Andrew G.
1874 Owen, Edward H.
1870 Putzel, Mayer.
1874 Pell, Robert L.
1860 Stewart, Alexander.
1874 Scribner, John Blair.
1857 Taylor, Bayard.
1873 Weeks, John A.
1875 Woodruff, Gen. J. H.
1868 Zaborowski, Martin.

List of Foreign and Domestic Geographical and other Scientific Bodies with whom this Society is in communication and constant exchange of publications.

Academia Real das Sciences, Lisbon, Portugal.
Academy of Natural Sciences, Philadelphia, Pa.
Academy of Natural Sciences, Davenport, Iowa.
Academy of Sciences, St. Louis, Mo.
Academy of Natural Sciences, Minneapolis, Minn.
American Antiquarian Society, Worcester, Mass.
American Naturalist, Salem, Mass.
American Social Science Association, Detroit, Mich.
Astor Library, New York.
Bibliotheca National, Rio Janeiro, Brazil.
Boston Society of Natural Sciences, Mass.
Bureau of Education, Washington, D. C.
Caucasian Geographical Society, Tiflis, Russia.
Central Bureau of Statistics, Stockholm, Sweden.
Circolo Geografico Italiano, Turin, Italy.
Commissão Central Permanente de Geographia, Lisbon, Portugal.
Cornwall Library, Cornwall-on-the-Hudson, N. Y.
Cosmos; Guido Coro, Turin, Italy.
Essex Institute, Salem, Mass.
Establissement Geographique de Bruxelles, Belgium.
Ferdinandeum in Innspruck, Austria.
Geographical Society, Lyons, France.
Geographical Society, Rio Janeiro, Brazil.
Geographical Society, Hamburg, Germany.
Geographical Society, Amsterdam, Holland.
Geographical Society, Marseilles, France.
Geographical Society, Munich, Germany.
Geographical Society, Dresden, Germany.
Geographical Society, Hermannstadt, Austria.
Geographical Society, Copenhagen, Denmark.
Geographical Society, Bremen, Germany.

Geographical Society, Madrid, Spain.
Geographical Society, Weimar, Germany.
Geographical Society, Bombay, India.
Geographical Society, Quebec, Canada.
Geographical Society, Metz, Germany.
Geographische Anstalt, Gotha, Germany.
Geological Society, Edinburgh, Scotland.
Geological Survey, Montreal, Canada.
Gesellschaft für Erdkunde zu Berlin, Germany.
Gewerbeschule, Bistritz, Austria.
Historical Society, Iowa City, Iowa.
Historical Society, Madison, Wis.
Hungarian Academy of Sciences, Pesth, Hungary.
Hydrographic Office, London.
Imperial Russian Geographical Society, St. Petersburg.
Imperial Royal Academy of Sciences, Vienna.
Imperial Geographical Society, Vienna.
Instituto Historio Geografico del Rio de la Plata, Buenos Aires, S. A.
Institut Geographique International, Berne, Switzerland.
Kais. Königl. Geologische Reichsanstalt, Vienna.
Königl. Gesellschaft der Wissenschaften, Gottingen, Germany.
König-Sächs Gesellschaft der Wissenschaften, Leipzig, Germany.
L'Exploration, Paris.
Library of Congress, Washington, D. C.
Library Department of State, Washington, D. C.
Literary and Philosophical Society, Liverpool.
Literary and Philosophical Society, Manchester, England.
Literary and Historical Society of Quebec, Canada.
Melbourne Observatory, Melbourne, Australia.
Ministère de l'Agriculture, de l'Industrie et du Commerce, Rome, Italy.
Museo Nacional de Mexico, Mexico.
Mexican Geographical and Statistical Society, Mexico.
Natural History and Philosophical Society, Belfast, Ireland.
Nature, London.
Naval Institute, Annapolis, Md.
Naturforschende Gesellschaft, Emden, Germany.
N. Y. State Museum of Natural History, Albany.
N. Y. State Library, Albany.

Philosophical Society, Wellington, New Zealand.
Polymathic Society, Vannes, France.
New York Academy of Sciences, New York.
Pulkowa Observatory, Pulkowa, Russia.
Real Academia Española Arqueologica y Geografica, Madrid, Spain.
Revue de Geographie, Paris.
Revue Geographique, 37 Rue Scheffer, Paris.
Roumanian Geographical Society, Bucharest.
Royal Geological Society, Dublin, Ireland.
Royal Society of Victoria, Melbourne, Australia.
Royal Danish Academy of Sciences, Copenhagen, Denmark.
Royal Geographical Society, London.
Royal Academy of Sciences, Munich, Germany.
Royal Society of Sciences, Upsala, Sweden.
Royal Prussian Statistical Bureau, Berlin.
Royal University, Christiania, Norway.
Royal Society, London.
Royal Cornwall Polytechnic Society, Cornwall, England.
Royal Academy of Sciences, Brussels, Belgium.
Royal Institute for Philology, Geography and Ethnography of Dutch India, The Hague, Holland.
Royal Dutch Meteorological Institute, Utrecht, Holland.
Royal Hungarian University, Pesth, Hungary.
Royal Asiatic Society, London.
Section of the Imperial Russian Geographical Society, Orenburg.
Smithsonian Institution, Washington, D. C.
Sociedade de Geographia, Lisbon, Portugal.
Société de Geographie, Geneva, Switzerland.
Société de Geographie, Rochefort, France.
Société Belge de Geographie, Antwerp, Belgium.
Società Geografica, Italiana, Rome.
Société de Geographie, Paris.
Société Khediviale de Geographie, Cairo, Egypt.
Société Belge de Geographie, Brussels, Belgium.
Société des Sciences Naturelles, Cherbourg, France.
Société de Geographie Commerciale, Bordeaux, France.
Société Normande de Geographie, Rouen, France.
Société de Geographie de Montpellier, France.

Société Suisse de Topographie, Geneve, Switzerland.
Society of Natural Sciences, Buffalo, N. Y.
Statistical Society, London.
Statistische Amt des Deutschen Reichs, Berlin.
The Academy, London.
The Asiatic Society, Yokohama, Japan.
The Japan Gazette, Yokohama, Japan.
Poughkeepsie Society of Natural Science, Poughkeepsie, N. Y.
Toukiyan Geographical Society, Tökio, Japan.
U. S. Geological Survey, Washington, D. C.
United States Coast Survey, Washington, D. C.
Verein für Erdkunde, Darmstadt.
Verein für Geographie und Naturwissenschaften, Kiel, Germany.
Verein von Freunden der Erdkunde, Leipzig, Germany.
Victoria Institute, or Philosophical Society of Great Britain, London.
Zeitschrift für Geographie, Lahr, Baden, Germany.

ADDITIONS TO LIBRARY AND MAP-ROOMS OF THE SOCIETY DURING THE YEAR 1879.

PURCHASES.

Encyclopædia Britannica, Ninth Edition, N. Y., 1878, 8 vols ; Historical Magazine, 2d and 3d Series, N. Y., 1867–71, and 1872–73, 11 vols: Geographie du Mogen Age, par J. Lelewel, Bruxelles, 1832–37, 5 vols ; L'Histoire de la Cosmographie, par le Viscomte de Santarem, Paris, 1849–52, 3 vols; Geschichte der Erdkunde Von Oscar Peschel, München, 1878 ; Ritter's Geographisch-Statistisches Lexicon, 1874, 2 vols ; Mentona and San Remo, by Edward Lee, M.D., London, 1869 ; Russia and the Poor, by Rev. R. Hibbs, London, 1876 ; On the Nature of Thunderstorms, by W. S. Harris, London, 1843 ; Silver's Handbook of South Africa, London, 1875; Elements of Navigation, by St. Lawrence Gwynne, London, 1805; Medical History of the Expedition to the Niger, by James O. McWilliam, London, 1863; Universal Gazetteer, by J. Walker, London, 1822; Universal Gazetteer, by John Moose, New Haven, 1821; The Queen's Regulations for Governing H. M. Naval Service, London, 1844 ; Voyages to Portugal, Spain, etc., by J. Collins, Phildelphia, 1809; Caledonian Sketches, by Sir John Carr, London, 1809; The Bahamas, by Surgeon Major Bacot, London, 1869; Western Clearings, by Mrs. Kirkland, N. Y., 1845; The Practical Navigator, by John H. Moore, London, 1828; Paraguay, Brazil, etc., by C. B. Mansfield, Cambridge, 1856; Wanderings in North Africa, by James Hamilton, London, 1856 ; The New Zealanders, London, 1830 ; The Hindoos, London, 1835; Eastern Africa, by Sir Bartle Frere, London, 1874; The London Gazetteer, by R. Brooks, London, 1832; South Australia, by Josiah Boothby, London, 1876; South Districts of New Zealand, by E. Shortland, London, 1851; Siege of Kars, by H. Sandwith, London. 1856; Geografia Politica dell'Italia, Firenze, 1845; Brazil, River Plate, etc., by William Hadfield, London, 1854; Travels in East Africa, by L. McLeod, London, 1860, 2 vols; A Tour Round the Baltic, by N. W. Wraxall, London, 1807; Letters from the East, by Wm. Cullen Bryant, N. Y., 1869; Travels in Koordistan, Mesopotamia, etc., by J. B. Fraser, London, 1840, 2 vols; An Account of the Kingdom of Canbul, by Hon. M. Elphinstone, London, 1839, 2 vols ; History of Lake Champlain, by P. S. Palmer, Plattsburgh, 1853 ; My Last Cruise, by

A. W. Habersham, Philadelphia, 1857; Journal of a Residence in Norway, by S. Laing, London, 1851; Seven Months in Russian Poland, by Rev. F. L. M. Anderson, London, 1864; Hungaria and Transylvania, by John Paget, Philadelphia, 1850, 2 vols; Dr. Grant and the Mountain Nestorians, by Rev. Thomas Laurie, Boston, 1853; Arctic Expeditions from British and Foreign Shores, from the earliest times to 1875–6, by D. M. Smith, Edinburgh, 1877; Italy, by Lord Broughton, London, 1859, 2 vols; The Pedestrian in France and Switzerland, N. Y., 1853: A Tour in Sweden, by S. Laing, London, 1839; Observations on the European People, by S. Laing, London, 1850; Dover, by S. J. Davies, London, 1869; Up the Tigris to Bagdad, by F. C. Webb, London, 1870; France in 1829–30, by Lady Morgan, London, 1831, 2 vols; From Singapore to Borneo, by George Earl, London, 1836; Notes of a Voyage to California, by Samuel C. Upham, Philadelphia, 1878; Indian Miscellany, edited by W. W. Beach, Albany, 1877; Helon's Pilgrimage to Jerusalem, by Fr. Strauss, London, 1824, 2 vols; Journeying in Russia, by Thos. W. Knox, Harford, 1877; A Journey from London to Genoa, London, 1770, 2 vols; Travels of the Jesuits, by Balthazar Tellez, London, 1710; Christopheri Cellarii Geographia Antiqua, Londini, 1808; Essay on the Theory of the Earth, from the French of M. Cuvier, Edinburgh, 1815; Publications of the Royal Society of Northern Antiquaries, Copenhagen, 1840–44, 1849–52, 2 vols; Shores of the Polar Sea, by Dr. E. L. Moss, London, 1878; Abhandlungen über Erd und Völkerkunde von Oscar Peschel, Leipzig, 1877–78, 2 vols; Ritter's Geographisches Lexicon, Leipzig, 1874, 2 vols; Nomina Geographica, von Dr. J. J. Egli, Leipzig, 1872; Réformes dans les Iles de Cuba et de Porto-Rico, par Porfirio Valiente, Paris, 1869; Systema Cosmographicum autore Joanne Gigante, Hannoviæ, 1615; Detectio Freti Hudsoni, Amsterdam, 1878; Die Geographische Erforschung des Afrikanischen Continents, von Ph. Paulitschke, Wien, 1879; Tour through Holland, etc., in 1806, Philadelphia, 1807; Egypte et Ethiope, par P. Tremaux, Paris, n. d.; Le Loudan, par P. Tremaux, Paris, n. d.; Le Desert et le Loudan, par le Comte de Lauture, Paris, 1858; Handbook of Abyssinia, by George Peacock, London, 1867; The Heroes of the Arctic, by Fr. Whymper, London, n. d.; History of Egypt under the Pharaohs, by Henry Brugsch, London, 1879, 2 vols: Palestine, Past and Present, by Rev. H. S. Osborn, Philadelphia, 1859; Description of the Maritime Ports of France, by Thomas Jeffreys, London, 1761, 2 vols; Histoire de la Marine Française, par E. Sue, Paris, 1835, 2 vols; France, by Lady Morgan, Philadelphia, 1817; Travels in Eastern Africa, by N. Isaacs, London, 1836, 2 vols; African Memoranda, by Capt. Phil. Beaver, London, 1805; A Winter in Iceland and Lap-

land, by the Hon. A. Dillon, London, 1840, 2 vols; A Pilgrimage to Auvergne, by Louisa Stuart Costello, London, 1842, 2 vols; Béarn and the Pyrenees, by Louisa Stuart Costello, London, 1844, 2 vols; Recollections of Travels in the East, by John Carne, London, 1830; Letters from the East, by John Carne, London, 1829, 2 vols; Incidents of Missionary Enterprise, by A. R. Bonar, London, 1849; Voyages and Adventures in South Africa, by A. Steedman, London, 1835, 2 vols; The Statesman's Year Book for 1879, edited by Fred. Martin, London, 1879; Midnight Marches through Persia, by Henry Ballantine, Boston, 1879; Géographie de Ptolémée, par Victor Langlois, Paris, 1867; Die Loango Expedition, 1873–76, von Paul Güssfeldt, Leipzig, 1879; A Particular History of the Five Years' French and Indian War, by Samuel G. Drake, Albany, 1870; The Rule of the Road at Sea, etc., by Commodore J. A. Jenkins, Washington, 1868; Rules and Regulations relating to H. M. Ships at Sea, London, 1803; Expéditions Suédoises de 1876 au Yénissei, par F. Schulthess, Upsal, 1877; Popular Treatises on Sciences written during the Middle Ages, edt. by Thomas Wright, London, 1841; A Cyclopædia of Missions, by Rev. H. Newcomb, N. Y., 1835; Origin and History of Missions, by Rev. J. O. Choules and Rev. Thomas Smith, N. Y., 1851; Travels of eminent English Missionaries by Andrew Picken, London, 1831; Sketches of a Journey in Chili, etc., by Lt. Isaac G. Strain, New York, 1853; Missions in Western Africa, by Rev. S. A. Walker, Dublin, 1845; Mission to the Jews in 1839, Philadelphia, n. d.; Maritime Discovery and Christian Missions, by John Campbell, London, 1840; Travels in the East, by John Gadsby, London, 1856; History of the Oregon Mission, by Rev. G. Hines, Buffalo, 1850; Memoirs of the Rev. David Brained, New York, 1822; Military Operations in Eastern Maine and Nova Scotia, by F. R. Kidder, Albany, 1867; Sir William Penn, Knight, Albany, 1876; The Settlement and Indian War in West Virginia and Pennsylvania, by Jos. Doddridge, Albany, 1876; History of the African Mission, by Mrs. Hening, N. Y., 1850; Life and Writings of James Bruce, by Alex. Murray, Edinburgh, 1838; Voyage of John Clarke, Esq., to America, by E. B. O'Callahan, Albany, 1867; John Clarke's Pilgrims, London, 1625, 5 vols; Haydn's Dictionary of Dates, N. Y., 1878; The Albatross, by Sir James E. Alexander, Stirling, 1863; Histoire de l'Astronomie Ancienne; du Moyen Age et Moderne, par M. Delambre, Paris, 1817–21, 5 vols; Bibliographie Astronomique, par Jerome de Lande, Paris, 1803; Biographie Universale, par le docteur Hoefer, Paris, 1852–70, 46 vols; Asia de Ivao de Barros, Lisbon, 1778–88, 24 vols; Diccionario Geografico de las Islas Filipinas, Madrid, 1850, 2 vols; Bibliotheca Americana Vetus-

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Periodical Publications to date.

Part I.

TRANSACTIONS

OF THE

SOCIETY FOR THE YEAR 1879.

TRANSACTIONS OF THE SOCIETY FOR 1879.

Annual meeting held at Chickering Hall, corner of Eighteenth Street and Fifth Avenue, New York, on Tuesday evening, January 14th, Chief-Justice Daly, President of the Society, in the chair.

The reading of the minutes of the previous meeting was, on motion, dispensed with.

The following named gentlemen, on the recommendation of the Council, were declared duly elected members of the Society:

Fellows.—Edgar Evertson Saltus, Leonhard Simion, William Everett, Arthur B. Graves, William G. Hamilton, Ellis Y. Samuel, L. E. Thorne.

Corresponding Member.—Henry F. Walling, Esq., Boston, Mass.

The Treasurer, Mr. George Cabot Ward, read his annual report, showing a cash balance to the credit of the Society, in the general fund, of $982.19, and in the permanent fund of $6,727.31. The report was accepted and ordered on file.

The annual report of the Council for 1878 was then read by Mr. William Remsen, Chairman, and, on motion, was accepted and ordered on file.

The Committee on Nominations presented the following report:

The Nominating Committee appointed to select officers to fill vacancies, under resolution of the Society passed at its meeting, December 12th, 1878, respectfully report the selection of the following nominees for election, in accordance with chap. 5, sec. 2 of the by-laws, viz.:

For President—Charles P. Daly, term to expire January, 1880.

For Vice-President—General George W. Cullum, U. S. Army, term to expire January, 1882.

For Foreign Corresponding Secretary—Rev. Roswell D. Hitchcock, D.D., term to expire January, 1882.

For Treasurer—Levi P. Morton, term to expire January, 1880.

For Councillors—William E. Curtis, William H. H. Moore, George Cabot Ward, Isaac Bernheimer, Paul B. Du Chaillu, terms to expire January, 1882, and Egbert L. Viele, term to expire January, 1880.

Respectfully,

(Signed) John MacMullen (Chairman),
Henry W. Dunshee,
Alexander McLeod Agnew,

Committee.

The above report was, on motion, unanimously adopted.

The Society then proceeded to a ballot, which resulted in the unanimous election of the above-given ticket.

Major A. G. Constable was introduced, and read a paper upon "Afghanistan: the Present Seat of War, and the Relations of that country to England and Russia." It was illustrated by stereopticon views.

On motion, the thanks of the Society were extended to Major Constable for his able paper, and a copy of it was requested for publication.

On motion, the Society adjourned.

Meeting of February 11th, held at Chickering Hall, New York.

General George W. Cullum, Vice-President, in the chair.

The reading of the minutes of the previous meeting, January 14th, was, on motion, dispensed with.

The following named gentlemen, on the recommendation of the Council, were declared duly elected members of the Society:

Fellows.—Col. Robert Harris, James G. Cooper, Charles B. Dahlgren, Richard P. Williams, Herbert H. Smith, George Hodges, Thomas Jordan, Ellwood E. Thorne, R. C. Stone, Myron Griffin Peck, Francis Speir, Jr., Henry F. Osborn.

Chief Justice Daly, President of the Society, was introduced, and delivered his "Annual Address upon Cartography: The History of Map-making previous to the time of Mercator," illustrated with stereopticon views and maps, showing the ideas that have prevailed in the world at different periods, as to the nature and form of the earth.

The thanks of the Society, on motion, were given Chief Justice Daly, and a copy of his very learned address requested for publication.

On motion, the Society adjourned.

Special meeting of February 27th, held at Chickering Hall, New York.

Chief Justice Daly in the chair.

Lieut. T. B. M. Mason, U. S. Navy, was introduced, and read a a paper entitled, "The Preservation of Life at Sea," illustrated by stereopticon views and models.

The thanks of the Society, on motion, were given to Lieut. Mason, and a copy of his very able paper requested for publication.

Meeting of March 11th, held at Chickering Hall, New York,

Chief Justice Daly in the chair.

The reading of the minutes of the previous meetings of February 11th and 27th were, on motion, dispensed with.

The following named gentlemen, on the recommendation of the council, were declared duly elected members of the Society:

Fellows.—James Morton Redmond, Richard O'Gorman, Jr., Simeon E. Church, G. W. C. Clarke, and James T. Brady.

General R. E. Colston, late of the General Staff, Egyptian Army, delivered a lecture on "Life in the Egyptian Deserts," illustrated by stereopticon views, mostly from original drawings.

The thanks of the Society were extended to General Colston for his valuable paper, and a copy of it was requested for publication.

On motion, the Society adjourned.

Meeting of April 8th, held at Chickering Hall, New York,

Chief Justice Daly in the chair.

The reading of the minutes of the previous meeting, March 11th, was, on motion, dispensed with.

The following named gentlemen, on the recommendation of the council were declared duly elected members of the Society:

Fellows.—William I. Marshall, William Austin, Francis A. Watson, Oliver Adams, Joseph Agostini, Felix Astoin, John E. Alexandre, Charles D. Adams, Mortimer C. Adams, John W. Aitken, Edward C. Arthur, Lucius C. Ashley, Henry C. Babcock, Frederick E. Mather, A. A. Hayes, Jr., Thomas O'Brien, Theodore B. Bronson, and Frederick W. Stevens.

Mr. William I. Marshall read a paper on "Two Summers in the Yellowstone National Park—with a description of the Wonders of that region," illustrated by beautiful colored stereopticon views.

On motion of Hon. Luther R. Marsh, the thanks of the Society were given to Mr. Marshall for his very interesting paper, and a copy of it was requested for publication.

On motion, the Society adjourned.

Meeting of May 13th, held at Chickering Hall, New York,

Chief Justice Daly in the Chair.

The reading of the minutes of the previous meeting, April 8th, was, on motion, dispensed with.

The following named gentlemen, on the recommendation of the Council, were declared duly elected members of the Society:

Fellows.—E. Reuel Smith, Towson Caldwell, Eben Baldwin, Gilbert S. Coddington, George E. Dodge, Edwin Einstein, Robert Goelet, Jr., Edward C. Delavan, Ferdinand Motz, Charles H. Woodbury, and Richard Crowley, M. C.

Mr. A. A. Hayes, Jr., F.R.G.S., read a paper on "Modern Ocean Highways," illustrated by stereopticon views.

On motion, the thanks of the Society were given to Mr. Hayes for his interesting paper, and a copy of it was requested for publication.

On motion, the Society adjourned.

Meeting of November 18th, held at Chickering Hall, New York,

Chief Justice Daly in the Chair.

The reading of the minutes of the previous meeting, May 13th, was, on motion, dispensed with.

The following named persons, on the recommendation of the Council, were declared duly elected members of the Society:

Fellows.—Maurice Wirths, A. O. Lambert, C. A. Barattoni, John Fahnestock, Julia Rhinelander, Prof. Charles W. Shields, Capt. F. B. Hamilton, U. S. Army, Cornelius R. Agnew, M.D., George

Wilcoxson, Edward Gebhard, Francis Lynde Stetson, Catherine L. Wolfe, John R. Fellows, Ferdinand P. Earl, R. A. Caldwell, M.D., Joseph R. Thompson, Royal C. Vilas, Gen. Edmund S. Bowen, Augustus H. Levy, Robert J. Turnbull, Grant Squires, John Bleecker Miller, Catherine L. Spencer, S. Nicholson Kane, William H. Inman. James Monteith, William Jay, and John Jacob Astor.

Corresponding Member.—Gen. Horatio G. Wright, Chief of Engineers, U. S. Army, Washington, D. C.

The Rev. Dr. Roswell D. Hitchcock offered a resolution, which was adopted, of regret at the death of the Rev. Joseph Parrish Thompson, D.D., LL.D., who had been a member of the Society since 1854.

The following resolution, offered by Mr. Francis A. Stout, Vice-President of the Society, and seconded by Dr. Isaac I. Hayes, was adopted :

WHEREAS, Mr. James Gordon Bennett, with unabated desire to assist in solving the remaining great geographical problems of the world, has dispatched the steam yacht *Jeannette* upon a voyage of Arctic discovery through Behring's Straits ; and

WHEREAS, The high reputation of its officers for science and seamanship, coupled with the thorough and generous preparation and outfit provided by Mr. Bennett, and the navy discipline of the crew, are as complete an assurance of success as can be afforded ; therefore

Resolved, That this Society congratulates its Fellow and good friend, Mr. Bennett, upon the success of the expedition so far as heard from, and renews the expression of its appreciation of his continued and liberal interest in geographical science.

Resolved, that the President be requested to transmit this preamble and resolution to Mr. Bennett.

The President then introduced the Right Honorable Earl of Dunraven, who read a paper on "Moose and Cariboo Hunting in the wilds of Canada."

Dr. Hayes moved that a vote of thanks be tendered to Lord Dunraven, for the evening of enjoyment which he had given the Society, and a copy of his paper be requested for publication ; seconded by Hon. Edwards Pierrepont, and carried unanimously.

On motion, the Society adjourned.

Meeting of December 9th, held at Chickering Hall, New York, Chief Justice Daly in the Chair.

The reading of the minutes of the previous meeting, November 18th, was, on motion, dispensed with.

The following named gentlemen on the recommendation of the council, were declared duly elected members of the Society :

Fellows.—Joseph E. Gay, Charles H. Isham, Lucien S. Ashley, Samuel B. Dana, Bobert M. Ferris, George W. Childs, Salem T. Russell and Samuel Elliott.

Corresponding Member.—Prof. Raphael Pumpelly, Washington, D. C.

The President, upon a motion appointed Messrs. Clinton Roosevelt (Chairman), John E. Body and Marshall O. Roberts, as the Nominating Committee, to select suitable candidates for officers of the Society, under Chapter V, Section 2 of the By-laws, and to report at the Society's annual meeting in January, 1880.

Colonel T. Bailey Myers, a member of the Society's Council was introduced and read, by request, a paper by Rear-Admiral Daniel Ammen, U. S. Navy, on "The Proposed Interoceanic Ship Canal Across Nicaragua."

On motion, the thanks of the Society were extended to Admiral Ammen, for his very valuable paper, and a copy of it was requested for publication. (See Bulletin No. 4, 1879.)

A motion offered by Col. Myers was passed, that the rooms of the Society be opened on evenings to be named hereafter, for the further discussion of the Interoceanic Ship Canal subject.

On motion, the Society adjourned.

Special meetings of December 15th, 22d and 29th, held at No 11 West 29th Street, New York,

Chief Justice Daly in the Chair.

The object of the meetings being for the discussion of the Interoceanic ship canal question. (For details, see Bulletin No. 4, 1879.)

Part II.

PAPERS READ BEFORE THE SOCIETY

DURING 1879.

Note.—The Authors alone are Responsible for the Contents of their Respective Papers.


GERARD KREMER
MERCATOR

ANNUAL ADDRESS.

ON THE EARLY HISTORY OF CARTOGRAPHY, OR WHAT WE KNOW OF MAPS AND MAP-MAKING, BEFORE THE TIME OF MERCATOR.

By CHARLES P. DALY, LL.D.,
President of the Society.

THE pressure of my judicial duties this year have made it impossible for me to examine the numerous sources of information which are requisite to give in an annual address, as I have done for many years, an account of the geographical work of the world. I have therefore substituted for it an account of what we know about maps and map-making before the time of Mercator—a subject I have previously investigated, and which, I trust, will prove interesting, as very little is to be found respecting it in any book in our own tongue; and, with the exception of the learned Portuguese, Viscount Santarem's Essay on the Cosmography and Cartography of the Middle Ages, the Polish geographer Lelewel's work upon the geography of the same period, and a brief paper by the late M. D'Avezac upon the history of the projection of geographical maps, there is nothing specially devoted to such an inquiry—at least, so far as I know—in any language.

It is now more than three centuries since Gerard Krehmer, better known to the world by the Latinizing of his name as Mercator, produced his large map of the world. The field of my inquiry is before this, and as it extends over a period of more than 2000 years, in respect to which our knowledge is very imperfect, it is not to be expected that I could, within the limits of an address like this, go very fully into details or enter upon a critical investigation of the subject, which is an obscure and difficult one. All, therefore, that I propose to do is to give, in a general way, some

account of what we know, with such conjectures as may be reasonably indulged in.

The origin of maps is involved in as much obscurity as the invention of letters. The cartographic art is probably as old, or older than the invention of the alphabet. We know that the art of writing began with pictorial representations of objects, which is still distinguishable in the Egyptian hieroglyphics, the earliest form of writing with which we are acquainted; and we may fairly assume that long before letters were invented to represent the articulate sounds in human speech, by an arrangement of which any spoken word can be put in writing, that man had sufficiently advanced in the knowledge of the arts of design, to be able to represent the position of countries, cities and towns, the course of rivers, the situation of seas, the locality of mountains, or other distinguishing features of the earth's surface, by some form of delineation, or map, so far as he had occasion for it; for this art has been found in use amongst races who had had no previous contact with civilized man—races that had never advanced so far as to invent a written language. Parry and Ross were astonished to find that the Esquimaux understood their charts; that they were able to recognize upon them not only the outlines of coasts and the positions of places, but to continue the drawing of the coast lines in the delineation of portions of the Arctic unknown to the explorers. Parry published several of these Esquimaux charts, or maps, which, when further explorations were made, were found to be remarkable for their accuracy. Nor is this art confined to the Esquimaux, for the North American Indians have, and have always had, maps which, however rude they may appear to us, are intelligible and serviceable to them.

One of the earliest things known in the nature of a map is the ground plan of a town, now in the Koyunjik gallery of the British Museum, which has been identified by Mr. Loftus as representing with minute accuracy the ground plan of Susa, the Shushan of the Bible, a city of remote antiquity, situated on one of the streams that flow into the lower Euphrates, a little to the north of the head of the Persian Gulf, the country from whence the people or race came that built Babylon, and founded the Chaldean civilization. The age of this topographical work is unknown, but it is assumed to be as old, at least, as the seventh century before Christ. It represents,

in a rude form of design, the plan of the town, its walls, the citadel, the king's palace, and a central square, surrounded on three sides by what is either a wall or a colonnade of buildings of uniform character. On the remaining side of the square is a large gateway, and the suburbs surrounding the town are represented as planted with date trees, and interspersed with buildings to the banks of the river.

The Egyptians had maps of some kind. One of their sacred books was wholly devoted to the subject of geography; but what it contained we do not know. They had also a learned official class at Memphis, called the "Hir-seshta of all the countries," who are supposed to have been geographers. In the earlier period of their civilization they kept, like the Chinese, closely within their own limits, trading only with the people upon their immediate borders—although it is known that even then, in one or two instances, they sent out intelligent men to gather information respecting certain parts of Asia. As they increased in civilization and power, they acquired, at a comparatively early period, a considerable knowledge of the geography of the world as then known. The military expeditions and conquests of Thutmes III, 1600 B. C., and Rameses II, the Sesostris of the Greeks, 1333 B. C., extended over Asia to Nineveh on the Euphrates, and to the confines of India. They extended also over a large part of Northern Africa, to the north of Greece and almost to Central Europe, embracing nearly the whole world, as known to the ancients. These conquests, however, were but transitory, it being easier to make them than to maintain them; but they were so extensive as to give to the Egyptians, necessarily, a large amount of geographical information; and as they were a highly civilized people, when Greece was yet in the heroic age, they probably retained this knowledge through a long course of centuries.

As they had, like the Chaldeans, made great progress in the science of astronomy, they doubtless had some general idea of the true form of the earth, and possibly both of its revolution upon its axis, and of its annual revolution around the sun, of which there are some indications. That they had maps, we know to be a fact, from recent information. There is a papyrus preserved in the museum at Boolak containing a map of Lake Moeris on the Nile. It shows the plan of the basin, with its canal and the position of towns and of

certain sanctuaries upon the borders of the basin, with explanatory texts giving information respecting these places. There is also an old Egyptian map preserved at Turin, of what is now Wady Alaiki, where the Nubian gold mines were situated, in the land anciently called Aki-ta. It is a mountainous country, of dreary, sterile, waterless valleys, where men and beasts died upon the roads to these mines. The map shows the mountain tracts, the rocks, and the places where gold was found; the ore-bearing mountains being marked in red color. It also shows the wells, a temple erected to Amon on the mountain, and the appurtenances and buildings in the gold districts. The roads, which had been abandoned, leading to the sea are also given. "Nothing," says Brugsch Bey, "is forgotten calculated to give the spectator an idea of the state of the region, even to the stones and the scattered trees along the roads."* This description is sufficient to show that the Egyptians knew the value of maps, and that they made and used them. These gold mines were worked in the reign of Rameses II, and if this map was made at that period, as from the description given of it would seem to be the fact, then it is the oldest map known. There is a passage in Apollonius of Rhodes, which is supposed to refer to the maps used by Rameses II, but it is too uncertain to predicate anything positive upon it. This information, which, as far as I have been able to ascertain, is all that has come down to us, is too limited to enable us to judge what progress the Egyptians had made in the cartographical art, but the probability is that they did comparatively little for its advancement, as they were at no time a migratory, colonizing or navigating race.

It was very different, however, with their neighbors, the Phœnicians. They were the great maritime nation of antiquity, making constant voyages along the coasts of the Mediterranean on either side, and along the western coast of Europe, as far as Great Britain, and possibly farther. The outlines of a coast once seen would, it is true, be sufficiently preserved in the memory for the practical purposes of navigation ; but a people who had extended their voyages so far, who had established so many colonies, and to whom is attributed the invention of the alphabet, would naturally be led to the

* Brugsch Bey, Egypt Under the Pharoahs, vol. 2, p. 79 ; *id.* vol. 1, p. 169, Lond., 1879.

construction of charts, from their utility, as well as maps to give some general idea of the world, of which they knew more than any other people. A jealous commercial policy kept them from imparting their knowledge to others, so that we do not know whether they had maps or charts, which is not remarkable, as we know, in fact, so little respecting them.

It is from the Greeks that we get our earliest knowledge of geographical maps. The first information we have upon the subject is from passages in Herodotus and in Strabo. Strabo says that Anaximander, who was born B. C. 612, was the first who represented the world upon a map. Diogenes Laertes ascribed to him the invention of geographical maps, and also of the gnomen, the simple instrument very much like our own sun dial, with which the ancients, in connection with the clepsydia or water-glass, made their astronomical observations; but the gnomen is known to have been in use among the Chaldeans long before the time of Anaximander. He may have introduced it into Greece, which was enough to have the invention of it attributed to him, for the Greeks were very like our English brethren—if any one of their countrymen was connected with the introduction among them of a new art or discovery, he was frequently declared to be the inventor. The passage in Herodotus is more definite and more interesting than the one in Strabo. He says that, according to the report of the Lacedemonians, Aristagoras, when he went (504 B. C.) to Cleomenes, the King of Sparta, to induce him to invade Persia, he produced before the Spartan King "a bronze tablet, upon which the whole circuit of the earth was engraved, with all its seas and rivers."

It has, until recently, been fashionable amongst historical critics to repudiate many of the statements of Herodotus, and this passage has not escaped. It has been pronounced impossible, or exaggerated. I see nothing impossible or exaggerated about it. If Anaximander had, about half a century before, constructed a geographical map, there is nothing remarkable in the statement that Aristagoras should bring with him an engraved representation of the circuit of the earth as then known, to show the Spartan King where the country was situated he was solicited to invade.

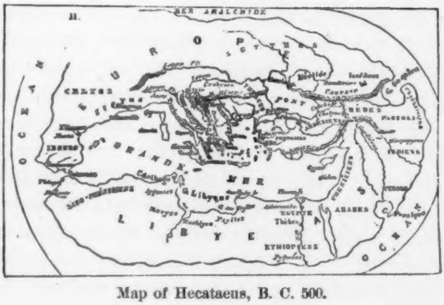
It has been said that Anaximander knew that the earth was a sphere, and so constructed his map, but I apprehend that there is

no ground for such an assumption. Diogenes Laertes says that he was the first person who drew a map of the earth and sea, and that he made a globe. But Laertes wrote in the second century of our era, about seven centuries after the death of Anaximander, and was simply giving what he was then able to ascertain respecting him. It appears from earlier and better-informed writers, such as Aristotle and Plutarch, that Anaximander's idea of the earth was, that it was of a cylindrical form, in the shape of a long pillar, the upper part or face of which was the portion inhabited.

Hecataeus, who lived in the same century with Anaximander, is believed, from passages in Agathemerus and Herodotus, to have corrected and improved the map drawn by Anaximander, and it is inferred, from statements in subsequent writers, that it was his map which Aristagoras exhibited to the King of Sparta, or one drawn up according to Hecataeus' views of the physical structure of the earth. Hecataeus was, for his time, an extensive traveler. He was well acquainted with Egypt and Western Asia, and embodied the information he had collected in his travels in two geographical works, that have not come down to us, which were of great authority for several centuries after his time.

What these early maps were we do not know, but can form a reasonable conjecture. The earth at that time was supposed to be a flat circular plain, or disc, the broadest part being from east to west, which was entirely surrounded by an ocean, or great river, that washed it upon all sides. In about the centre of this plain Greece was supposed to be situated. The great central sea of the inhabited region was the Mediterranean. The farthest point known at the west was the Straits of Gibraltar, then called the Pillars of Hercules. The southern part comprised the north of Africa as far as the deserts; whilst the region north embraced the countries bordering upon the Mediterranean, and an unknown hyperborean land farther to the north, with the Euxine and Caspian Seas at the northeast. The farthest eastern point known was about the western limit of India. This was what would then be contained in a map as a representation of the earth. The sun was supposed to pass under and around this flat plain, which was then the mode of accounting for the changes of day and night. The space beneath was supposed to be a great vault, called Tartarus, the abode of the spirits of the wicked among men, as the region

Homer's World.



Map of Hecataeus, B. C. 500.

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corresponding to it, above the plain, was the heaven, or abode of the Gods. The unknown region beyond the Pillars of Hercules was filled up with creations of the fertile imagination of the Greeks. To the northwest and north were the Cimmerians, a people living in perpetual darkness; and the hyperboreans, a race supposed to be exempt from toil, disease or wars, who enjoyed life for a thousand years in a state of undisturbed serenity. To the west of Sicily were the enchanted islands of Circe and Calypso, and the floating island of Eolus. A little to the north of the Pillars of Hercules was the entrance to the infernal regions, and far out in the Western Ocean, beyond the limits of the known earth, was the happy region called Elysium, a land of perpetual summer, where a gentle zephyr constantly blew; where tempests were unknown; and where the spirits of those whose lives had been approved by the gods dwelt in perpetual felicity. Here also were the gardens of the Hesperides, with their golden apples guarded by the singing nymphs, who dwelt on the river Oceanus, which was in the extreme west, and the position of which was constantly shifted, as geographical knowledge increased. No doubt, the unknown and fabulous was mingled with what was known, in the map of Hecataeus. Herodotus, who wrote a century later, had evidently a poor opinion of it, or at least of the maps existing when he wrote. He says, "For my part, I cannot but laugh when I see numbers of persons drawing maps of the world without having any reason to guide them; making the ocean stream to run all round the earth, and the earth itself to be an exact circle, as if described by a pair of compasses." The last remark may possibly have been applied to some attempt to construct a map with reference to the globular form of the earth, for Parmenides, a contemporary of Herodotus, is said by Diogenes Laertes to have been the first person who asserted that the earth was of a spherical form, and that it was situated in the centre of the universe; and the same idea was entertained by Socrates, who was in the enjoyment of a wide-spread reputation more than twenty years before the death of Herodotus. Strabo credits Parmenides also with having been the first to divide the globe into five zones, or, as they were then called, climates. The statement of so late a writer as Laertius, that Parmenides was the first to propound the true theory of the form of the earth, would not of itself be entitled to much weight, but the statement is

probably true, from what is known from contemporaneous sources. We know very little respecting the man who appears to have been the first, at least in Greece, to express a belief in the rotundity of the earth. Plato, who calls him the great Parmenides, says that he was a native of Elea, on the west coast of Italy, and that he came to Athens when rather an old man, with hoary locks and a handsome, noble aspect, and that Socrates then became acquainted with him, so that it is not impossible that it was from him that Socrates received his impression of the spherical form of the earth. Socrates says, as recorded by Plato, "the earth is neither of such a kind or of such a magnitude as is supposed by those who speak of it, as I have been persuaded by a certain person," who may have been Parmenides. Afterwards, in the same dialogue, he refers to the supposition that the earth is of a spherical form, and is in the middle of the universe, and argues that it has no need of anything to prevent it from falling; that it is a thing in a state of equilibrium, placed in the middle of something which presses it equally on all sides, and therefore remains immovable. Although he evidently believed the earth to be of a globular form, his ideas respecting it, and especially as to the character of its surface, were not very clear or definite. It was not so, however, with Aristotle, who, half a century afterwards, was thoroughly convinced that the earth was a globe, and drew that conclusion from the shadow which it casts upon the sun in eclipses; from the fact that the polar distances diminish as we go to the north or the south, and from the tendency of all bodies to fall towards the earth; and after Aristotle's time, the fact that it was not a plain, but a round ball or globe, was generally accepted by the learned. They were, however, few in number; and as it was opposed to the evidence of the senses, it being hard to believe that the sea, which appeared to the eye to be level, was in fact convex, there is no reason to suppose that, at any time, it was a matter of popular belief, especially when we find that, four hundred years afterwards, so accomplished a man as Tacitus disputed it.

When the idea became firmly fixed in the mind of the learned that the earth was a sphere, it naturally followed amongst an artistic people like the Greeks that some attempt would be made to give a physical representation of it, and accordingly we are told that Crates, B. C. 326, constructed a globe of the inhabited part of the earth, from the arctic to the tropic, in the form of a half circle.

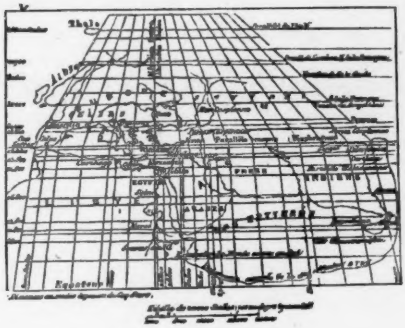
The zone about the tropics he represented as an uninhabitable portion entirely covered by water, a belief which existed for a long time afterwards, and the southern half beyond, as that of an unknown but inhabited region. Strabo refers to the globe of Crates, with which he appears to have been familiar, and describes how such a globe should be constructed, which he says, to present all the regions of the habitable earth accurately, should be at least ten feet in diameter. The diameter of the little globe I now hold in my hand, which took the prize at the Paris Exhibition, and contains more than Strabo ever dreamed of, is less than five inches.

Dicearchus, the Messinian, B. C. 296, a very accomplished man and the writer of several geographical works which are lost, constructed a map of the world in an oval form, which appears to have been highly estimated, and to have been the model upon which subsequent maps were made. We know that maps were in use from the time of Dicearchus to the period of Eratosthenes, but whether they were constructed with reference to the globular form of the earth, or how they were constructed, we have no information. It is inferable, however, from passages in the classic writers, that those at least in popular use conformed in respect to the unknown part of the world to the ideas deeply implanted in the popular mind by the poems of Homer and from other sources.

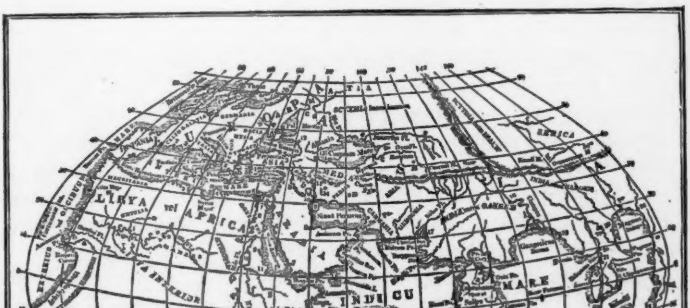
With Eratosthenes, who died about the beginning of the second century before Christ, the science of geography may be said to have begun. He was the first to apply a purely scientific method to ascertain the magnitude of the earth; for when a knowledge of the exact circumference of the globe was once obtained, the different countries and places could be arranged in these ancient maps, in their relative position to each other, far more accurately. The distances between places in what was then known as the inhabited part of the earth, was previously ascertained by the number of days it took to go from one place to another, derived from the information of travelers and mariners. This information, collected in the form of intineraries, was all that the ancient geographers had, which was not a very certain measure of distances even upon the land, and was much more uncertain when the journey was by sea, the vessel being subject to the caprice of the winds, and liable to be delayed by calms, head winds, storms, or other impediments; so that the number of days that a vessel took in sail-

ing from one place to another was a very unreliable means upon which to depend for computing the distances between places.

To rectify the errors which became more apparent and confusing as the inhabited part of the world became better known, Eratosthenes devised, what has ever since been employed, as the most accurate means of determining the circumference of the earth, the measurement of an arc of the meridian. He found a confirmation of the globular form of the earth in the fact that at Syene, in Upper Egypt, upon the tropic, the sun at noon on the day of the summer solstice was vertical; that is, that it cast no shadow, a well at the bottom being enlightened by its rays; whilst at Alexandria, upon the same day and time, it was distant from the zenith one-fiftieth of the circumference of the circle. He assumed, in which he was slightly inaccurate, that Syene lay due south from Alexandria, or, as we should now say, in the same longitude, and the distance between the two places having been measured by the royal overseers of the roads, Eratosthenes obtained by this means the length of what is called an arc of the meridian, or a portion of the curved surface of the earth; and from this he was able, by a familiar rule, to determine the circumference of the whole circle. The distance between Syene and Alexandria was found to be 5,000 stadia, which, being the one-fiftieth part of the circle, gave for the whole circumference 250,000 stadia. His measurement was not very precise, but it was a beginning, and a very important one. Having ascertained in this way what he considered to be the circumference of the earth, he, in projecting his map, drew parallel with the equator, a line from the Pillars of Hercules to the farthest known point of Asia, and adjusted the places north and south of this line, in what he supposed to be their true position. We do not know what means he adopted in the division of the globe to indicate the exact position of places for his geographical work, and the map connected with it is lost. Our information respecting what he did is derived from Strabo and others, and from passages quoted in Strabo, it appears that he speaks of parallel lines, lines at right angles, and sections, showing that he had some mode of marking the divisions of the sphere. This was a great advance, but it was not wholly satisfactory; for Hipparchus, the greatest astronomer of antiquity, three quarters of a century afterwards, criticised Eratosthenes' labors rather severely, and declared that, in some respects, the previous maps were preferable.

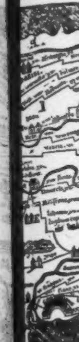


Hipparchus, 100 B. C.



Ptolemy's Map, A. D. 150.

p 10



The Peutingerian Table, illustrating the Roman Maps.

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The happy idea occurred to Hipparchus of applying to the earth the same method he had used in fixing the position of the stars in the celestial sphere. Regarding the earth as a great circle, which, like any other circle, is divisable into 360 degrees, he so divided it, by lines of circles drawn perpendicularly from the poles to the equator, and by parallel lines at equal distances from the equator to the poles; which was the beginning of the division of the globe by lines of longitude and latitude, into degrees; or, as the Greeks called them, the divisible parts of a great circle. When this was done a foundation was laid for scientific geography, and the more accurate representation of the relative position of places upon the earth's surface in the construction of maps. But although Hipparchus hit upon the true method to be adopted, he was, as will subsequently appear, very far from accurate when he came to work out his plan in detail.

The Romans, in their representation of the earth, would seem, at first, to have followed Eratosthenes and Hipparchus. All that we know, however, upon the subject, is very limited. About half a century before our era Posidonius, who was a geographer, and had been an extensive traveler, constructed a universal map of the world, in which he did not adopt Eratosthenes' measurement of an arc of the meridian; but, to conform his map to his own astronomical ideas, he greatly reduced the dimensions of the globe, and thereby fell into the grossest errors in respect to the true position of places. The habitable part of the earth he represented somewhat in the shape of a sling, the greater extent being from East to West, and the broader part being at the East. We know also that the Emperor Augustus, about sixty years afterwards, ordered the geographers and designers to prepare for the use of the people a map of the habitable world, which should represent fully the extent of the Roman Empire; and, from some fragments that were preserved, it is known that this map was a cylindrical projection of a great circle. The Romans, however, had a map for practical use which they styled a *descriptive itinerary*, or, as they sometimes called them, "*painted roads.*" This map was in the form of a band about a foot wide, and about 20 feet long, upon which the habitable earth was continuously represented along parallel spaces. These maps, which, it would appear, were derived from the Greeks, represented pictorially and as well as by writing, the great routes or roads of the

empire, the position of places, with the distances between them; the range of the mountains, the direction of rivers, and the situation of seas, with other information, partly in writing, but chiefly by drawing. This kind of map was mainly used for military purposes, and was regarded as a map of the world, for the vast extent of the Roman Empire comprised nearly all that was then known of the habitable world. These maps were very numerous, and being full of topographical information, were of great value. As they served for all practical purposes, there was little motive for the construction of scientific maps of the world; which, moreover, were probably not in very good repute, for the topographical information supplied by the itineraries showed that the scientific maps then in existence were, as to the position of places and the size of countries, full of errors.

As information respecting the inhabited part of the earth accumulated, as it did, during the three centuries after the time of Hipparchus, by the voyages of mariners, the journeys of travelers, and in a large degree by the military conquests of the Romans, his representation of the position of places and countries was found to be very inaccurate; and Marinus of Tyre, who lived during the second century of our era, undertook, by a general reconstruction of maps and the preparation of an accurate geographical work, to correct these errors. He studied with great care the works of his predecessors, collected all the information that was procurable from travelers and mariners, and produced a geographical work far beyond anything that had preceded it, illustrated by maps which were covered with a network of parallel and meridian lines, cutting each other at right angles, under which the different places were indicated according to their direction and distance from each other. His object was to put an end to the uncertainty about the position of countries and cities, by assigning to every locality or place its approximate latitude and longitude. He divided the globe into sections, each having an astronomical extent of fifteen degrees, and the places falling within these limits he put together in what he supposed to be their relative position to each other. He drew a line due east from the Fortunate Islands, and arranged countries and places in what he regarded as their proper position north and south of this line, so as to bring them alike under the proper zone or climate, as well as under the astronomical section he had devised;

but the interior towns that lay in the same parallel of latitude he merely placed along that line, one after the other, in their proper order. He undertook to combine the results of astronomical observation with the information supplied by the itineraries of travelers, which was very difficult to do—as it was not easy to reconcile the distances between places as given by travelers and mariners, with their position as indicated by astronomical observation, both modes then being very defective. The only means for astronomical observation at that time was the shadow cast by the gnomen. The ancient astronomer had no compass to determine the course or direction. He had not the delicate instruments we have now for ascertaining the altitude of an object when in or near the meridian, nor a chronometer to mark the intervals of time. The latitudes, as ascertained by the simple means he possessed, were not always correct within a degree, nor could the longitude be ascertained within two degrees. Errors of three or four degrees were not uncommon in the position of places situated in the same country, and when they were in distant countries the errors were much greater. The distances between places, as supplied by travelers, were very defective, for the reasons already stated, and yet it was only from their information that anything could be exactly known respecting the surface of the earth When the geographers, therefore, undertook to harmonize their information with the true form of the earth and the position of places, as fixed by astronomical observations, a multitude of errors was inevitable. Marinus had not only to correct errors which had been ascertained by subsequent and more accurate information, but he had collected a large amount of new material which had to be properly disposed of, and the consequence was that in providing for it and adjusting it in his general delineation of the earth, he greatly exaggerated the distance or length of the inhabited part, from east to west. He revised his work, making many alterations, and would no doubt have greatly improved it thereafter, had not his labors been cut short by a premature death.

The geography of his immediate successor, Ptolemy, which has fortunately come down to us, was written at least within half a century afterwards, and as Ptolemy himself says, was based upon the work of Marinus. Ptolemy's labor was what, in this day, we would call editing a new and revised edition of an existing work. It was written to correct Marinus's exaggeration of the distance

from east to west; so that the map of the world might conform to the true figure of the earth; and to correct mistakes, through Marinus relying too much on the statements of travelers, and to correct parts of the coast line of Africa, and an erroneous representation of the Venetian Gulf. Ptolemy was a much better mathematician and astronomer, but evidently very inferior as a geographer to his predecessor. He undertook to correct Marinus's chief error by reducing his projection of the earth, from east to west, from 225 to 180 degrees. In making this geometrical correction, however, he fell into a multitude of errors which, had he been a better geographer, he would readily have detected. As Marinus's work is lost, we have no means of comparing the one with the other to ascertain to what extent the errors that abound in Ptolemy existed in the work of his predecessor. The impression conveyed is that they were, in a large degree, due to Ptolemy's attempt to make everything conform to his reduced geometrical proportion, by which he distorted the figure of countries and adjusted the position of places in a way that an able geographer would not have done. With respect to the distances given by travelers, he appears not to have taken into account whether the Greek or the Egyptian measures were meant, which was like a geographer at the present day accepting distances in miles, without enquiring whether they were German or English miles. He made the Mediterranean one-third larger than it is; and where Eratosthenes and Strabo had estimated the distance of the known world as about two-sevenths of the whole, he made it about one-half, adding to the length somewhat over 40 degrees, and by the liberties which he took to carry out his geometrical idea, he no doubt effaced a great deal which would have been valuable in tracing the progress of early geographical knowledge.

It would appear, from what is said in Ptolemy's work, that there was a set of maps attached to it. An edition of Ptolemy was printed in Rome in 1478, with ancient maps, twenty-six in number. Whether they are copies of original maps belonging to Ptolemy's work is an unsettled question. All that is known is that these maps were attached to manuscript copies of Ptolemy, as old as the eleventh century, one of which is at Vienna and another at Venice; and that at the end of these manuscripts there is this statement: "Agathodæmon of Alexandria delineated the whole inhabited world, according to the eight books on geography of

CLAUDIUS PTOLEMY.

(From an Old Map.)

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Claudius Ptolemy." As all that is known of Ptolemy, apart from his works, is that he lived at Alexandria about the middle of the second century of our era; and as the Agathodæmon referred to is described as of Alexandria, it is supposed that they were contemporaries, and that the maps were designed under Ptolemy's direction, and formed a part of his work. There is, I think, a reasonable probability that this may be the fact: that they are Marinus maps, reconstructed under Ptolemy's direction by the Agathodæmon referred to. Marinus's maps were in existence in the tenth century of our era, for in the work of the Arabian geographer, Masudi (Kitab et tenbih), which was written A. D. 955, he says, in referring to the division of the globe into climates or zones: "I have seen these seven climates illuminated in various colors in several books, and the best I have seen of this kind was in the geographical treatise of Marinus of Tyre."

Geographical enquiry was arrested for many centuries after the time of Ptolemy, and the preservation of his work is doubtless due to the fact that, being the last of the eminent geographers of antiquity, it was supposed to embody all that the ancients knew upon the subject. His idea of the earth was that it was an immovable body in the centre of the universe, and he rejected as absurd the theories of the philosophers before his time, who believed in the rotation of the earth upon its axis, and in its annual revolution around the sun.

This belief, which, in one form or other, had existed for more than four centuries before the time of Ptolemy, may have been derived from the Chaldeans or the Egyptians, in both of which countries astronomical observations had been carried on for more than two thousand years before Christ with an assiduity and precision which the Greeks never gave to the investigation of the physical sciences. The idea of the movement of the earth appears to have been first entertained in Greece by the philosophers of the Pythagorean school. Pythagoras, himself, is said to have passed twenty-two years in Egypt in acquiring knowledge, and the philosophers of his school, whose names are connected with the advancement of this theory, spent more or less time in Egypt, so that it may be that it was from that country that they brought away whatever impressions they had upon the subject. What the sect as a body really believed or taught in respect to the motions of the earth, is difficult to say.

It is certain that several philosophers of that school controverted the prevailing impression that the earth was a flat plain. Philolaus, a Pythagorean, and a contemporary of Socrates, believed in a central fire, and that the earth made a daily revolution around it. Heraclitus, of Ephesus, B. C. 513, thought that the earth was not immovable, but had a slow motion. Plutarch says that Plato, who had always believed that the sun moved around the earth, changed his opinion towards the end of his life, and regretted that he had not taught that the sun was the centre of the universe. A passage in one of his works has been referred to, both by Pythagorean philosophers of his own age and by modern critics, as indicating that he had the true idea of the earth's motion, but conveyed it obscurely, from an apprehension of religious persecution.

This, however, has been disputed by Boeke, and Grote the historian, in reviewing the discussion upon this subject, infers that what Plato meant was not a diurnal motion of the earth, or its motion around the sun, but a motion in common with the other heavenly bodies around what Plato regarded as the axis of the universe. Theophrastus, who was a follower of Plato, declared, as quoted by Cicero and by Plutarch, that Hiretas, of Syracuse, thought that the sun, moon and stars stood still, and that it was the earth that moved ; that it revolved on its axis, but with such rapidity that it appeared as if it were the heavens that moved, and the earth that stood still, which is a very clear conception of the earth's motion. A like opinion is attributed by Plutarch to the Pythagorean Ecphantus, and to Heraclides Ponticus, who was a disciple of Plato. Aristarchus of Samos, B. C. 280, taught that the sun was a fixed star ; that the earth moved around it in an oblique circle, and also about its own axis. Plutarch says that he taught this hypothetically, but that Seleucus, the mathematician, asserted it positively. This, as far as can be collected, was the state of this enquiry when Ptolemy wrote: "There are," Ptolemy says, "people who pretend that there is nothing to prevent the belief that the heavens are immovable, and that the earth turns on its axis from west to east in the interval of a day. This is easy to believe on account of its simplicity ; but these people do not reflect how supremely ridiculous this is, when we consider what passes around us in the air. Lighter bodies, suspended in the air, would, if this were true, have a movement different from the earth. Neither the clouds, nor bodies thrown into the

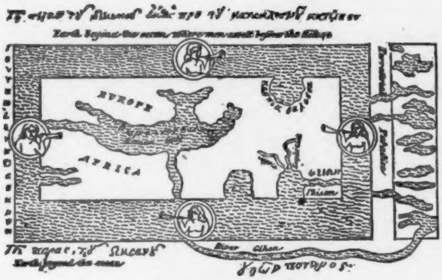
air, nor the birds, could go towards the east, because the earth would then precede them; and everything except it would seem to be going towards the west, &c. * * * * The earth is infinitely small compared with the universe, and is kept immovable in its place by the permanent effect which the universe that surrounds it exercises upon it." And this judgment the world accepted for more than a thousand years.

In this review of the geographical knowledge of the ancients, it is to be borne in mind that our information is very defective. The works of Eratosthenes, Hipparchus and Marinus of Tyre, have perished. The geographies of Strabo, Pomponious, Mela and Ptolemy are the only important works that have come down to us; and what we know of their predecessors is mainly through them. What has descended to us in respect to the early history of geography is so fragmentary that it may be described by what the historian Grote said of our stock of information of the ancient world generally, that "we possess only what has drifted ashore from a stranded vessel."

A period of 1200 years elapses from the time of Ptolemy to the inauguration, by Prince Henry, the navigator, of the spirit of maritime enterprise which led to the circumnavigation of Africa and the discovery of the continent of America. This long interval is marked by the decline in Europe of everything in the form of geographical knowledge, until a state of ignorance was reached, in which little interest was felt in any branch of human learning. For the purposes of our enquiry, it may be divided into three periods. The first was one of long continued and nearly incessant wars, during which the destruction of everything was so great that when it closed there was little remaining but fragments of the ancient civilization. This was followed by a period of repose, ignorance and torpor, to which succeeded another period, ending about the beginning of the 15th century, during which a limited few were slowly recovering a portion of the geographical knowledge that had been lost, and dimly groping their way to a true conception of the earth's form and laws. It would involve too much of detail to enter upon the history of this decay, to explain the state of ignorance that had been reached, the absurd ideas that became rooted in men's minds

in respect to the nature and the form of the earth, and the difficulty of overcoming them. I shall refer to these matters, therefore, only as far as they arise in tracing, from the fragmentary information we possess, the history of cartography during this obscure period.

But though geographical knowledge declined during this interval, and from the sixth to the middle of the eleventh centuries, the condition in Europe, except in Spain and in Ireland, was one of almost universal ignorance; there was throughout the whole of the period some attention, at least, given to geography—to the study of maps and to map making. It was, it is true, very little, and the greater part of it tended more to obscure than to enlighten; but at no time was the interest in the subject wholly extinct. For several centuries after the time of Ptolemy, or up to the separation of the eastern from the western half of the Roman empire, there was an almost uninterrupted study of geography in the schools of Alexandria, in which the fathers of the church, the philosophers, the soldiers and the emperors appear to have taken a warm interest. The maps then in use were itineraries or road maps, which were very numerous, as they were of service to the soldiers during the wars that were then and which continued long afterwards to be waged. In addition to these route maps, general maps were also constructed, to show at a glance the form and proportions of the habitable globe; and in the fifth century Theodosius II. caused a survey to be made of the provinces of the empire, which occupied fifteen years, from which a large map of the empire was compiled. There was also a geographical school at Ravenna, in Italy, which, after Honorius (A. D. 404) made Ravenna the capital of the western empire, became very active, but the cartographical labors of this school appear to have been limited to the production of descriptive itineraries or painted route maps. The authority of Ptolemy, during this period, declined. The Alexandrine geographers, no doubt, were better acquainted than he was with Asia, and knew the gross errors he had made in the configuration of countries and the position of places. But there was another and more potent cause that led to the discrediting of Ptolemy, as well as of all the ancient geographers. This was the disposition of the clergy, who for some centuries afterwards were the only learned class, to test all geographical knowledge by the standard of the Bible; and as the Bible afforded no authority for the opinion of the ancient geographers that the earth is a globe, their ideas and



Cosmos Map of the World.

Map of the World, 8th Century.

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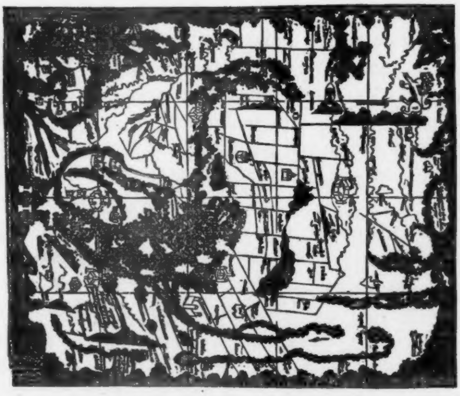
their works were generally rejected as contrary to Holy Writ. In the middle of the sixth century Cosmos, who had been a merchant, an extensive traveler, and who afterwards became a monk, was the writer of several geographical works, one of which has survived, in which he maintained that the idea of the earth being a globe was contrary alike to the Scriptures and to common sense ; sustaining his views by ingenious arguments, which, in that age, were very convincing. Cosmos was not an ignorant man; on the contrary, his account of the countries with which he was acquainted was accurate and valuable, and it was his topographical knowledge which made him so formidable an antagonist in disputing the rotundity of the earth. "There are," he says, "false Christians, contemnors of the authority of Scripture, who dare to maintain that the earth is a sphere. I combat this error, derived from the Greeks, by citations from Holy Writ." He then ridicules the idea that the earth revolves in space without axis, or anything to support it, and characterizes the belief of antipodes, or people living on the other side of a round globe, as old women's tales. Having thus disposed of the anterior belief, he proceeds to give his own idea of the earth, which he says no true Christian can doubt. It was, that the earth was an oblong plain, enclosed at its four extremities by huge walls of immense thickness, on which the firmanent or vault of the heavens rested ; and that near the North Pole there was a high mountain, around which the sun, the moon and the stars turned, the intervention of which mountain, at certain periods, caused eclipses.

From this point our knowledge is very obscure. It is the period of the dark ages. We know that in the seventh century they had maps in the monasteries of Ireland, for from the sixth to the ninth centuries there was an amount of learning in Ireland that was in striking contrast with the general ignorance that prevailed throughout Europe. In the eighth century Charlemagne brought many learned monks from Ireland and from England for the instruction of his people, and upon organizing his provinces he had constructed, it may be supposed, with the assistance of these monks, a general map of the world, which was engraved upon three large tables of silver. It did not exist, however, very long, for his grandson, Lothair, had the largest of these silver tables cut up into small pieces for distribution among his soldiers. The destruction of the other two probably followed in like manner, which is all that we know of this great map of Charlemagne.

We have now approached a period when Europe sank into the deepest ignorance. Communication between places was broken up through the long continuance of wars; roads were destroyed, there was little or no commerce, for traveling was difficult and dangerous, and people living in close proximity knew comparatively nothing of each other. It was, as I have before said, a period of rest and torpor, during which whatever was known respecting geography or maps was confined to the cloisters, where some interest in the subject was still kept up. In the 10th century an Anglo-Saxon map of the world was constructed in England, which is still preserved in the British Museum, though much injured by the ravages of time. It is a rude work, and very inaccurate; but in its general design and execution, it is in marked contrast with much ruder productions that followed it, and shows a knowledge of Roman geography, but a knowledge that was rapidly decaying.

Fortunately, however, this was not the state of things throughout the world. During the period that marks the rise, the maturity and decline of the empire of the Arabs, or from the 9th to the 13th centuries, geography was assiduously cultivated by them as a science-especially in Bagdad, the capital of the Caliphs, and for a part of that period in Spain. It is to the Arabians, and particularly to the geographical scholars of Bagdad, that we owe the preservation of the work of Ptolemy, which they translated into Arabic, and annotated; and they appear to have been well acquainted with what was known respecting geography as a science up to the point where Ptolemy left it. They determined the obliquity of the ecliptic, measured two arcs of the meridian, ascertained more accurately the longitude of places in Asia and about the Mediterranean, and enlarged descriptive geography by an account of the countries in Asia over which they had extended their conquests; for the Caliphs generally instructed their generals to give a geographical description of the countries they subdued. The Arabs had not only a knowledge of those parts of the interior of Asia which they added to their empire; but as early as the 9th century they trafficked in the ports of the Indian Ocean. They had intercourse also at that time with China, and it may be that it was through this intercourse that the mariner's compass was brought to the Mediterranean, for it was in use in China long before it was known in Europe. I may also mention, in this connection, that the Chinese, according to the state-

Map of the World, 10th Century.



Anglo Saxon Map, 10th Century.

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ments of their own writers, had maps from a very remote period. It is known that there was, in A. D. 265, a map of the empire on twenty-four pieces of silk; and a Chinese writer of about that period speaks of an atlas of maps representing China and the barbarous countries conquered by it. He describes these maps as representing the mountains, seas, rivers, lakes, plains, and basins; and says that they were compiled by the order of one of the Emperors. It appears, also, that there was a triangulation of the Empire, A. D. 721, and that, in the 9th century, when the Arabs were in communication with the country, a map of the world was constructed, A. D. 820, in which China was represented as in the centre of the earth. But to return to the geographical labors of the Arabs :

In the reign of the Caliph Al Mamoun, A. D. 830, a geographical work, founded upon Ptolemy, was written by the custodian of the library of Bagdad, Abou Djafer Mohammed Ben Mousa, which was the foundation for all the subsequent labors of the Arabian geographers. This great work, for such in that age it seems to have been, is called by the Arabs the Rasm, a word for which there is no equivalent in any other language. This work, unfortunately, is lost; but from the references to it by Arab writers, we know that it gave a description of the habitable earth, and indicated the prominent places in different countries by their latitude and longitude, correcting, in the countries with which the Arabs were well acquainted, the gross errors in longitude of Ptolemy. The work, which, in its form and execution, was a magnificent one, was accompanied by a planisphere, or general map of the world, which Massoudi, an Arabian geographer of the 10th century, who was familiar with the maps of Ptolemy and of Marinus of Tyre, saw, and pronounced superior to theirs.

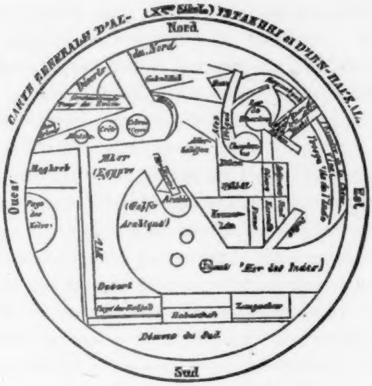
The Arabs, in their geographical works, after the manner of Ptolemy, gave catalogues, or tables of the latitude and longitude of places, wherever they had been ascertained by astronomical observation; and the tables in the Rasm were referred to so often and so fully by subsequent Arabic writers, that Lelewel was able, from these references, to reconstruct the greater part of this map.

It is from these catalogues, or tables of latitudes and longitudes, that we know the wide extent of the geographical knowledge of the Arabs. Their corrections from West to East extended from Cadiz to the Indus, and they restored to their true position the places in

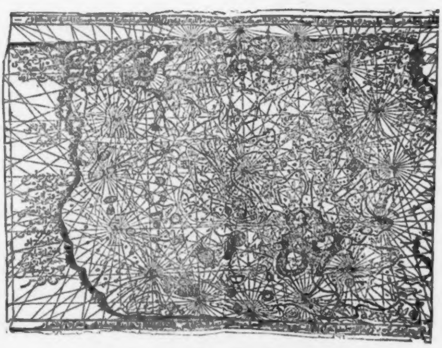
the countries watered by the Euphrates and the Tigris. It is inferable from statements of Arab writers that they had maps constructed upon a mathematical basis. As these maps have not come down to us, it is supposed that they were rare, and were not intended for practical use, but constructed to aid the inquiries of the learned; for the Arabians pursued the study of geography mainly in its connection with astronomy, and were not, as we would understand the term, topographers, or only to a very limited extent. We have one of their maps of the 10th century, and others of the 11th, 13th and 14th centuries, and if they are to be taken as specimens of what they could do in the construction of maps, they were very poor cartographers. Instead of delineating coasts or seas by lines representing the natural curvature of the coast, or shore, in several of them straight lines, or arbitrary curves, are used. Thus the Mediterranean is a long sea, enclosed within four straight lines, and other seas are represented as an exact circle. Everything is mathematicai—lines, curves, and circles—so that, upon first examining these maps, it is difficult to understand them.

It is rather for the preservation of what was previously known, that we are indebted to the Arabs: for, though they studied geography with great assiduity, they cannot be said to have greatly advanced it as a science. In the countries with which they were familiar, they corrected numerous errors, but in the countries unknown to them, they followed Ptolemy aud Ptolemy's system, and putting both together in their general delineation of the world, they produced the greatest confusion, so that their system of geography had, as will hereafter appear, but little effect upon the growth of the art of cartography in Europe, which was developed by methods entirely different from theirs, and owed nothing to their labors except a more accurate knowledge of Asia.

Most of the Arabic geographers accepted the conclusion of Ptolemy that the earth was a sphere, but as a body they do not appear to have come to any positive conclusion upon the subject. Some thought it was like a ball, the half of which was cut. Some thought it was an entire ball, and moved around. Others, that it was hollow in the interior. Edrisi, in the 10th century, thought that it was a globe floating in an ocean, like an egg in a basin of water, and that it was the half that was above the surface that was inhabited; whilst Kasuiny, in the 14th century, entertained



Arab Map of the World, 10th Century.


Arab Map of the World, A. D. 1009.

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Homer's idea that it was a flat plain environed by an ocean, which was also the opinion of Ibu Warde.

Leaving the Arabs and their labors for the present, we will now return to the growth of cartography in Europe. We have maps designed to represent the earth as known, or particular parts of it, from the 9th to the 15th century ; and which, from the rude efforts in the 9th century, exhibit the widest diversity in plan and execution. Some consist of straight parallel lines drawn across a circle, with the names of countries or places arranged along the lines. In others, the position of the Mediterranean is indicated simply by the name of the sea, and the names of countries and places are grouped about it in what was supposed to be their true position. In none of these early maps is there any attempt to give in curved lines the form of continents, or to indicate the boundaries of countries. In some, as in the Leipzic map of the 10th century, the circle is divided in the centre, the upper half of the circle being Asia, with Phœnicia, Troy, and Babylon, represented by three castles ; and the lower half is divided in the centre by a line separating Africa from Europe ; three rude curves denoting the Alps, and a few jagged lines the Pyrenees. Others are itineraries, or skeleton road books, arranged in successive parallel spaces, as in the Jerusalem Itinerary, which gave with much detail the route from Bordeaux to the Holy City. These itineraries mark the route from city to city, with the prominent castles or places on the way. Where a river had to be descended, or a gulf, or an arm of the sea crossed, it was pictorially represented, and in these general features they resembled and appear to be a continuation of the descriptive itineraries of the Romans.

About the middle of the 12th century, Roger, King of Sicily, determined to have a map of the world constructed from the best information that could then be obtained. For this purpose he sent intelligent men to various parts of the known world, to take the latitude and longitude of places, to collect itineraries, and gather every kind of information that was desirable. Fifteen years were spent in this preparatory work, and what had thus been obtained was entrusted to Edrisi, an Arabian geographer and traveler, who had been invited to the king's court, and from these materials Edrisi compiled a general map, which was engraved upon a round table, or globe of silver. In a manuscript in the National Library

of Paris, there are 69 maps supposed to have been copied from this silver globe, and there is a general copy of the map attached to a manuscript in the Bodleian Library at Oxford. This work of Edrisi was superior to anything that had preceded it in the Middle Ages. It appears to have given a new impulse to geographical inquiries, as it was compiled chiefly from the new materials that had been obtained; for Edrisi, upon examining the works of his Arabic predecessors and the work of Ptolemy, found that they had involved the general subject of geography in such doubt, uncertainty and confusion, that in constructing his map he rejected them altogether as sources of authority. Edrisi also composed a geographical work which has survived. Wherever in it he had to refer to the fabulous and impossible things asserted by his predecessors, he generally accompanied the statement with the formula, "God only knows how this is."

There is a large map of the world, of the 13th century, preserved in the Hereford Cathedral, in England, which, though compiled a century afterwards, exhibits none of the knowledge found in the map of Edrisi, or even in the previous Anglo-Saxon map of the 10th century. As a cartographical specimen, it is of the grossest kind, exhibiting not only the profoundest ignorance of the world in general, but an ignorance of England and Scotland, with which, it might be supposed, the compiler would be familiar. Whilst this is its character as a map, it is a most elaborate and carefully-executed work, as respects the writing and the embellishments. It is covered with religious conceptions, such as a representation of the Garden of Eden; the Expulsion of Adam and Eve; the Tower of Babel; the Several Apostles; Satan bearing off the Condemned; and with drawings of wild and fabulous animals, savages, castles, noted individuals, &c. Cosmos' conception of the oblong form of the earth with four walls had, since the 9th century, been abandoned, for the reason that the belief, after that time, became general that Jerusalem, the Holy City, was in the exact centre of the earth; and as Cosmos' plan would not harmonize with this idea, the circular form of the earth was restored. Thus the Hereford map is of an oval shape, and has Jerusalem in the centre of it.

The map of Ranulphus Hyggeden, A.D. 1360, may be taken as a specimen of the kind that was produced in Western Europe in the 14th century. The earth is represented as oval in form, and surrounded by water; the principal portion of the upper half of the

Edrisi's Map, A. D. 1154.

Ranulphus Hyggeden's Map, A. D. 1360.

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oval represents Asia ; the principal part of the lower half, Europe, while Africa occupies nearly the whole of the right of the map. There is some attempt to give the outlines of the Mediterranean and the Black Sea, and islands of the Mediterranean are represented, and the course of rivers, especially the Nile, the Euphrates and the Tigris, but erroneously and very rudely.

The map of the Italian Sanuto, which was constructed forty years before (A. D. 1320), on the contrary, is of a very different character, and shows the influence of the labors of Edrisi, an acquaintance with the Arab geographers, and a familiarity with Ptolemy, and other sources of information. The Mediterranean, the Euxine and the Caspian are for the time very well defined. Some idea is imparted of the mountain chains of Asia, and the source and the course of the Nile are given, as in the map of Edrisi. Some idea, although a rude one, is also imparted of the mountain system of East Africa, and the outline of the southern and eastern part of the continent of Asia shows some general acquaintance with that part of the world.

But it is unnecessary to dwell further upon these general maps, as they had very little to do with the improvement in cartography, which about this time began to make considerable progress. They were intended generally for the learned, and were of no interest to the bulk of the people. What the merchant or traveler required was an itinerary, or road book, which gave the great routes, the position of towns and cities, and their distance from each other, with such other information as was useful to those making journeys, and the voyager or mariner depended upon what was called a portulan, a small oblong book, which had the two-fold qualities of an almanac and a coast chart. On the cover of the portulan was a representation of the points of the compass, and a table of the days of the year, such as we have in our present diaries, and upon the sheets inside was a careful delineation of the outline of the coasts, the positions of seaports, and statements of the distances from one port to another, according to the direction of the compass, which was denoted by straight lines running in all directions; with which was comprised such intelligence as the depth of harbors and other nautical information of a practical character.

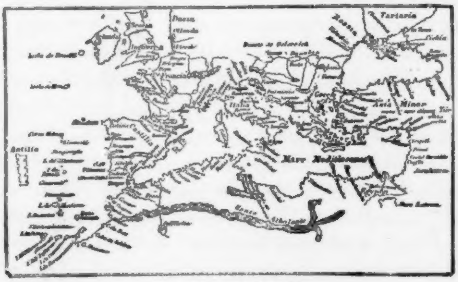
This was all that was wanted in that age by the traveler upon land, or the voyager by sea, neither of whom felt any interest in

maps of the world, the construction of which were left to the learned. But to supply what was required for these useful guides, the itineraries and the portulans, a mass of information had to be collected. For the itineraries it was gathered from merchants, pilgrims, ambassadors, and in fact from all who made extensive journeys by land, and was rarely of a scientific nature, as what these travelers brought back was descriptive accounts of the countries they had visited, and their ideas of the relative distances between places, or the number of days it took to go from one place to another. But the information required for the portulan was of a more scientific character, and laid the basis for such an improvement in cartography that the mariner was soon enabled, guided by the compass and his chart, to steer boldly out to sea without relying, as before, upon the stars when out of the sight of the land, which, in a comparatively short period, led to those extensive maritime discoveries that gave Europe a passage by water to the Indies, and revealed the continent of America.

To understand more clearly the rapid progress which was made in cartography in Europe in contrast with the little that was done for its improvement by the Arabs, although they had had the advantage for five centuries previously of the geographical knowledge of the ancients, it will be necessary to draw attention to the difference between the nature of the empire which they established by their conquests, and that era of maritime enterprise and commercial activity which sprung up, and after the 12th century developed so rapidly in the cities of the Mediterranean, such as Amalfi, Genoa, Pisa, Venice, Majorca, Cadiz, Barcelona, Bilboa and Lisbon.

The Arabs had a vast empire, the great bulk of which had no connection with the sea. Their capital, Bagdad, was in the interior of Asia, far up on the banks of the Tigres, and their empire was so great, and so rapidly acquired, that they did not and could not give much attention to the geographical examination of it in detail. A highly imaginative people, they were more attracted by speculative enquiries respecting the earth as a whole, and therefore studied it more in its connection with astronomy than by those careful, patient and practical topographical labors which constitutes such an important part of geography. What could be done by astronomical observation to show the relative position of places they did, and

Italian Itinerary, 13th Century.



Portulan, A. D. 1476.

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did somewhat extensively in Asia, but in respect to the sea they did little. They knew nothing of the Atlantic ; their geographers declared that it was navigable only to a certain extent, and that beyond that limit it was a sea of darkness.

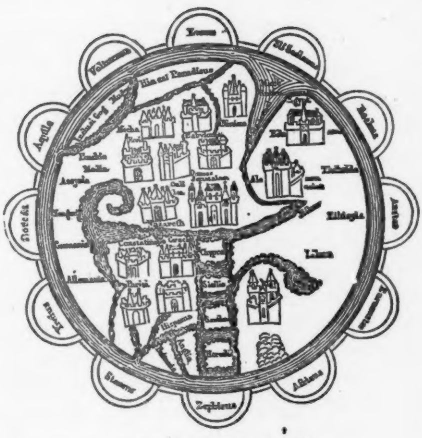
The people of the maritime cities of the Mediterranean, or the Latins, as they are frequently called, to distinguish them from the Arabs, had a field of activity very limited when compared with the great empire of the Arabs. It was the Mediterranean. Their pursuits were maritime. They were the carriers by water of products between Asia and Europe, and therefore became, what the Arabs never were, a nautical people. To them navigation and everything that tended to its improvement was of the highest interest, and they consequently gave great attention to details. They observed closely the outlines of coasts; carefully delineated them, and as they had an eye for form and proportion, their maps, in design and execution, greatly excelled those of the Arabs.

In the thirteenth century the mariner's compass came into general use in the Mediterranean, and as this greatly extended the maritime commerce of these cities, it was impossible to do without nautical maps and charts. A map of the world like Edrisi's was of no use to the pilots or mariners. What they wanted were special maps or charts, giving the outline of the coasts, the position of harbors, the nautical distances by the direction of the compass, with everything as aids to navigation that could be represented upon a map or connected with it, and to supply this want a class of men sprang up in these maritime cities, known by the name of cosmographers, who devoted themselves to the production of all kinds of nautical maps, special as well as general. These cosmographers studied the marine routes, collected from the itineraries of voyages and from other available sources, every kind of information that could he useful, and in this way a vast amount of material was collected, which served as a basis for the construction and improvement of nautical maps. It was not only collected, but carefully preserved, being transmitted by one cosmographer or cosmographical school to his or their successors. These cosmographers cared little for the scientific labors of the Arabs. They did not, in constructing their nautical maps, avail themselves of the longitudes and latitudes collected by the Arabs, or construct their maps upon any mathematical or scientific basis, as they knew from practical ex-

perience that the positions of places obtained in this way were unreliable. Whatever geographical knowledge, therefore, they acquired was practical, and the result was a rapid improvement in cartography, for what they laid down upon their maps was what had been obtained from actual observation. Pilots and mariners also made charts from their own observations, and all information procured in this way was carefully collected and preserved. In preparing the portulan for the mariner, the care of the cosmographer was to give as accurately as possible the outlines of coasts, and to indicate the promontaries, the dangerous points, the shallow places, the reefs, the curvature of gulfs and bays, the sinuosities of the shore, and to fix the distance of one position from another with some exactitude. In addition to this, the portulan was annotated with other information useful to the mariner, and these portulans furnished the material for more general charts and maps of the world, for they gave as a foundation for maps an exactness which did not previously exist.

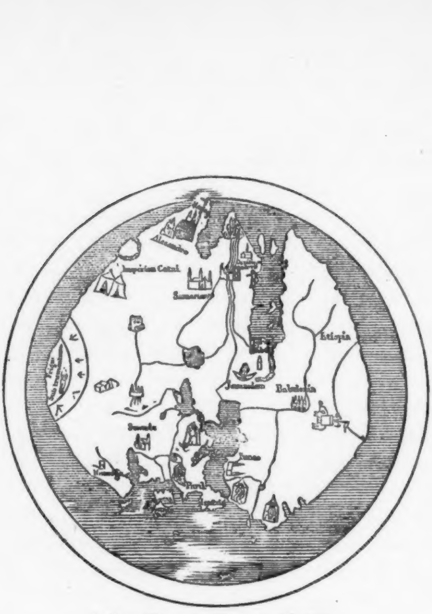
These cosmographers knew very well the position of places to the pole, or geographical latitude, but in making their maps they drew no parallels of latitude, and paid less attention to longitude; for the mariners for whose use these maps were intended knew nothing about figures representing degrees of latitude and longitude, and they are consequently not found upon these maps. The distances on the land or over the sea were laid down from certain fixed points in the direction of the compass, and hence these maps are covered with a network of lines running in all directions from central points, called wind roses (*Rose de Vent*), which, to persons familiar only with maps of the present day, are unintelligible.

The Catalans, who were extensively engaged in navigation, became especially distinguished in the thirteenth and fourteenth centuries for the fabrication of portulans, as well as for the construction of maps in general; and in 1375, Charles V of France sent to the Catalan cosmographers to have a map of the world executed, which resulted in the transmission to him of an atlas of six maps, executed upon vellum and illuminated in colors, and richly embellished with gold and silver, the whole enclosed in a volume. Four of the maps of this atlas constituted a general map of the world, which is what is known as the celebrated Catalan map. It was extensively copied and reproduced in a cheap form in all the



St. Denis Map, 14th Century.

p 26



Andrea Bianco's Map, A. D. 1376.

Fra Mauro's Map, A. D. 1457.

p 29

maritime cities of the Mediterranean for the use of mariners. Each master of a vessel, or, as he was then called, pilot, had a copy of it, and for a long time it was the map in use for all practical purposes.

In the 15th century, great acquisitions were made to the knowledge of the world, especially in Asia and Africa, by the journeys of Marco Polo and Cadamosto ; and the result of this accumulation of new information was the construction, in 1457, of a large map of the world, by Fra Mauro. It was painted on the wall of a convent in Venice, and was, for its time, an admirable production. It is not only remarkable for the extent of the geographical information it embodies, but for the artistic skill with which it is executed, and the cleverness with which the different parts of the world are brought together and represented as a whole, although, when examined in detail, it is very defective.

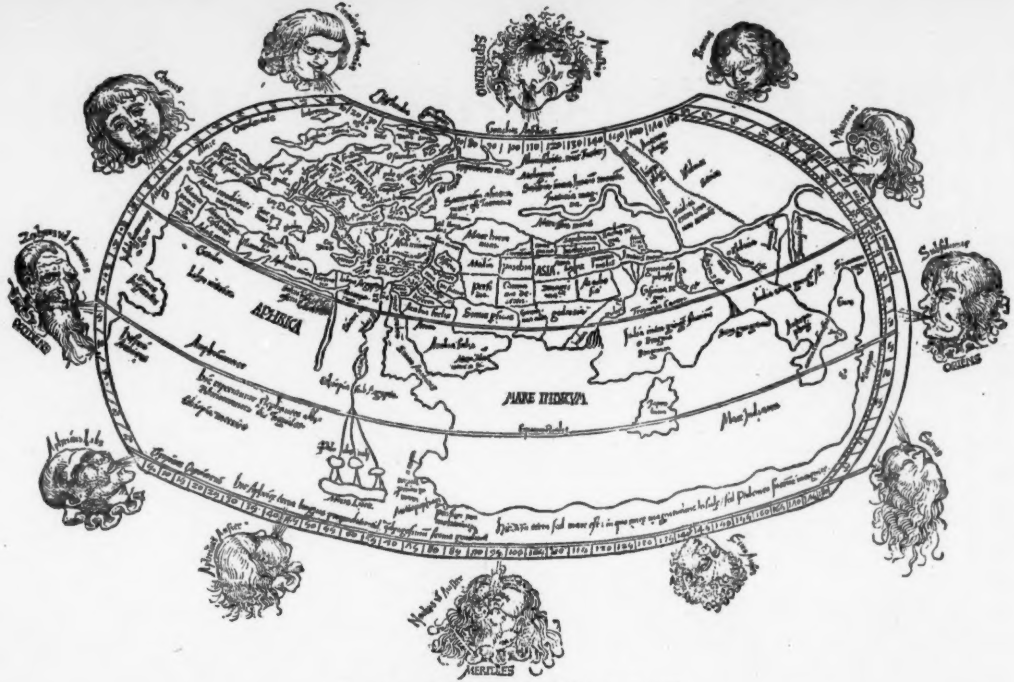
Fra Carmelite was a friar who had established a geographical school in Venice, and whose acquisitions as a geographer were, for the time, so extensive, that he received from his contemporaries the title of "*the incomparable.*" He knew that the earth is a sphere ; being well acquainted with Ptolemy, but did not follow Ptolemy's scientific method, of so projecting the world as to give the longitude and latitude of places. He represented the whole earth as embraced within a circle, giving to each part its proper relative position, being of the opinion that that was the most effective way of representing the whole world upon a map ; and, considering the peculiarity of his plan, his map was a very successful cartographical achievement.

It should be stated as explanatory of the defective construction of general maps of the world at this time, and before it, that the belief of the ancients in the globular form of the earth was far from being generally accepted. Even amongst cosmographers there was great uncertainty as to its real form. Columbus thought it had the shape of a pear, and in fact, its spherical form was not fully admitted until Magellan's vessel, in 1521, sailed around it. In Italy, however, the belief of the ancients, both as to the form and as to the motions of the earth, was revived as early as the middle of the 15th century. Cardinal Cusa, who was a contemporary of Fra Mauro, maintained that the motion of the heavens was apparent, and that it was the earth that moved. He declared also that the earth was not a perfect sphere, and that in its

movement in its orbit it departed, to some extent, from a circle—a declaration that was very remarkable as suggesting what was afterwards ascertained, the eccentricity of the earth's orbit. Towards the close of that century, in Italy, the doctrine of the earth's rotation became quite general, and was the subject of public discussion in the schools of Bologna, which was more than half a century before the appearance of the great work of Copernicus, who, in all probability, got the idea which he afterwards worked out so successfully during that part of the early period of his life, which he passed in Italy.

About forty years before the map of Fra Mauro was executed, Prince Henry of Portugal, surnamed the Navigator, began to send out those expeditions along the western coast of Africa, which was the beginning of that brilliant age of maritime exploration that led to the circumnavigation of the Cape of Good Hope, the discovery of the continent of America and the voyage of Magellan's vessel around the world. During this period of active discovery, the limits of Africa were greatly extended to the South, a vast continent was revealed by the discovery of America, and the knowledge of the earth being thus largely augmented, a general map of the world had to be differently arranged and represented by new methods.

The first step in this direction was made by Toscanelli, a learned cosmographer of Florence. He constructed a map, now lost, the object of which appears to have been to represent the eastern portion of Asia, and the islands to the east and south of it, a part of the world unknown to Ptolemy, but with which Toscanelli had become acquainted through the travels of Marco Polo, and others, and also to show that Asia could be reached by sailing westward from Portugal, directly across the then unknown Atlantic; and in 1474 Toscanelli sent this map, accompanied by a letter, to Columbus, to confirm the great discoverer in the design he then entertained of attempting to sail westward across the Atlantic to the Indies. In this map Toscanelli divided the space between the western shores of Portugal and the eastern part of Asia into twenty-six divisions or spaces of 250 miles each, and probably laid down the eastern part of Asia with Marco Polo's outlying islands of Cipanga (Japan), Java, &c., as they are found on the globe of Martin Behaim, supposed to have been constructed in the year that Columbus discovered



Map of the Margarita Philosophica, A. D. 1508.

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America (1492), and which geographical information, it has been inferred, Behaim acquired from the map of Toscanelli.*

This map is supposed to have been projected after the manner of Ptolemy, incorporating the information obtained by Marco Polo ; but how imperfectly Toscanelli understood the real dimension of the earth is shown by the fact that he represented the distance from Lisbon across the Atlantic to Asia, or the space where the then unknown continent of America is situated, as 6,500 geographical miles across, which is about one-half the actual distance. In 1478 the maps of Agathodaemon, before referred to, were published, and the effect of the continuation of these maps in subsequent editions of Ptolemy was gradually to restore the scientific method of the ancients and of the Arabs, of dividing the globe into degrees of latitude and longitude. In 1503 George Reisch, the prior of a chartreuse at Fribourg, published a kind of manual of general knowledge, *Margarita Philosophica,* that was very popular in the 16th century, and passed through many editions. It was accompanied by a map of the world, to which I refer, because it is the earliest of that period with which I am acquainted in which the method of Ptolemy was followed, of dividing the map of the globe into degrees of latitude and longitude. The projection was spherical, but it was an imperfect representation of a sphere, for the obvious reason that its author, like his contemporaries generally, was uncertain as to the exact form of the earth. It is truncated or cut off at the Arctic circle and at the 25th parallel south of the equator, giving to the map the shape of a curved oblong, the length of which from east to west is twice as great as from north to south. As respects geographical information, it added comparatively little to the map of Ptolemy, there being no indication upon it of what Marco Polo had ascertained respecting Asia, or of the discovery of America, or of the exploration of the Portuguese along the western coast of Africa, although the Portuguese discoveries had then been going on for more than half a century, and the continent of Africa had been circumnavigated seven years before this book of Reysch was published. It is known that the book was in existence some years before it was printed, and the map which accompanied the

* 1 Irving's Columbus, p. 57.

first edition in 1503, was probably constructed many years previously.

The first map upon which the discoveries of Columbus appear is that of John Ruysch, in the edition of Ptolemy printed in Rome in 1508. Ruysch adopted the method of Ptolemy of projecting the earth in the form of a cone, with the Arctic at the summit, but so expanding the cone as to bring in the western hemisphere and show the islands and a part of the main land discovered by Columbus and others. In 1511 Bernard Sylvanus produced in his edition of Ptolemy a general map of the world, upon what has since been called the cordiform, or heart-shaped projection, which, while giving the whole of the geographical features of the earth, was, from the curve and sweep of the parallels of both latitude and longitude, better adapted than anything that had preceded it to convey upon a plane surface a general idea of the earth's globular form. In this map the newly discovered continent of America, under the name of The Land of the Holy Cross (Terra Sanctæ Crucis), was laid down more fully and accurately than in the preceding map of Ruysch. In the following year, 1512, a Polish geographer, John de Stobnicza, in an introduction to Ptolemy, published a map which I regard as of great interest, as it was, as far as I have been able to ascertain, the first attempt to project the spherical surface of the earth upon a plane. If I am right in this supposition, it was the parent of the mode now in use in all atlases of representing in a map of the world both sides of the globe upon a flat surface by two planispheres, or circular maps joined together, one of which includes Europe, Asia and Africa, and the other America, North and South.*

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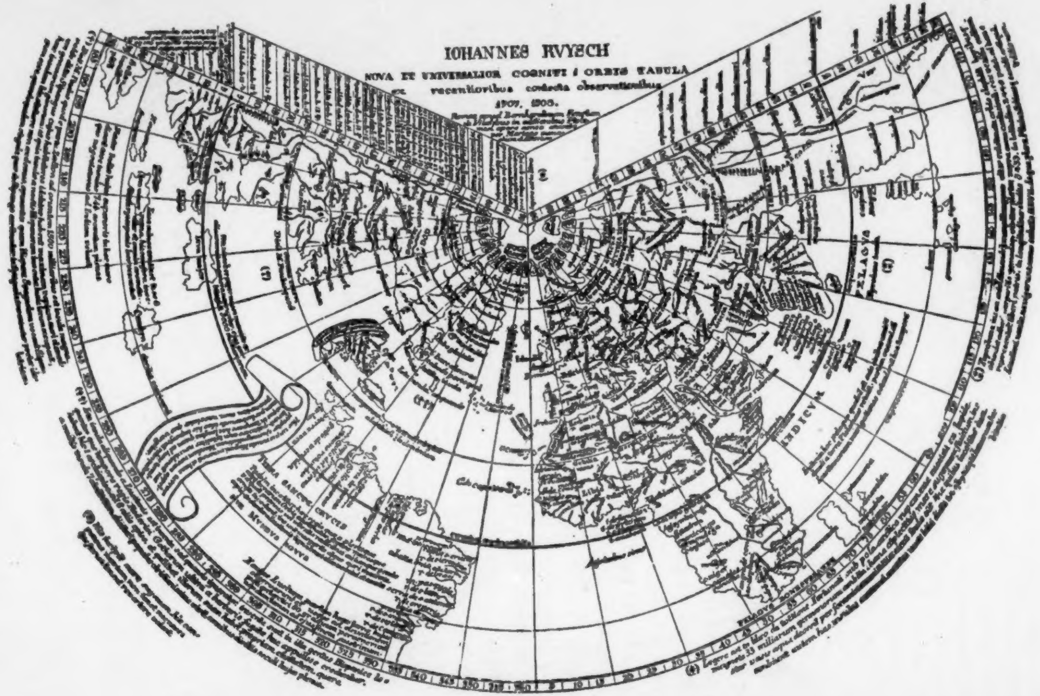
* *Letter of J. Carson Brevoort Esq., February* 20, 1879: * * "I think you were right in assuming that the Mapamundi found in Stobnicza's Introduction to Ptolemy of 1512 was the first attempt to project a spherical surface on a plane in what might be called a *partial* and *subspherical projection truncated at the poles.* D'Avesac had not seen this map nor the *rectiparallel projection* proposed by Apianus in 1524. Oronce Fine, in his Protomathesis, Paris 1532, gives rules and diagrams for the old planispheric. The single heart-shaped projection appears first, as you said, in the mapamundi of Sylvanus. The double cordiform projection or artificial development of a sphere on a plane, by Oronce Fine, in 1531, must have been considered as a mere *tour de force* only, for he does not allude to it in his Protomathesis and Cosmography.



John Ruysch, A. D. 1508.

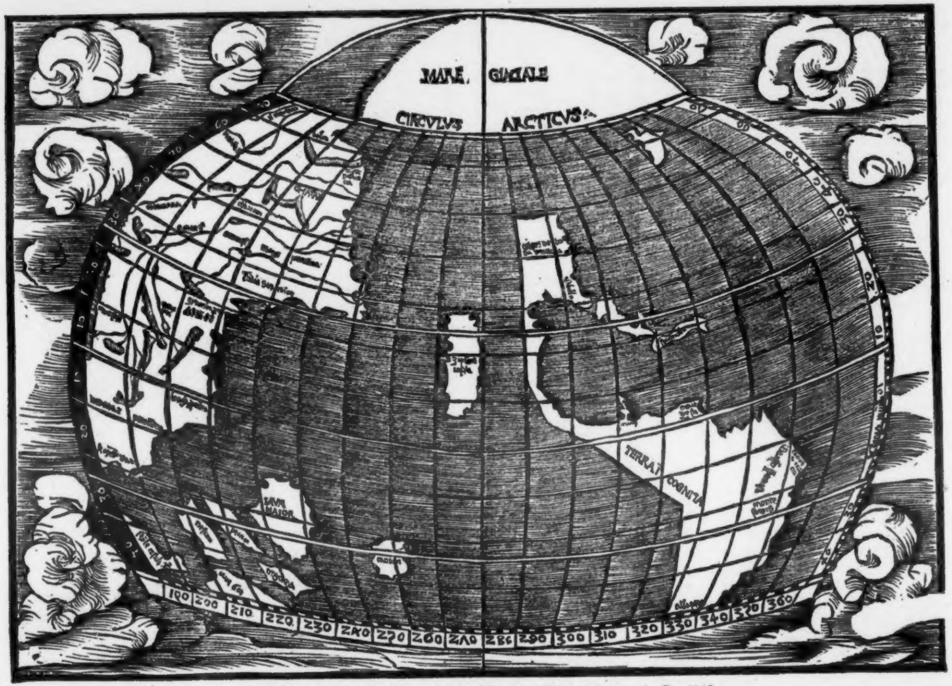
p 32

Sylvanus' Map, A. D. 1811.

Sylvannus' Map, A. D. 1511.

p 32

p 33



John de Stobnicza's Map of the Western Hemisphere, A. D. 1512.

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This map was constructed to represent that half of the globe which was unknown to Ptolemy, or substantially what is now known in maps of the world as the western hemisphere. Stobnicza says in his Introduction that he had been careful to make notes about certain parts of the earth with which Ptolemy and other old writers were unacquainted, which he says had become known through the travels of Americus Vespucius and others; that there were three parts of the earth already known, but that there was a fourth part, which had been discovered by Americus Vespucius—a large part of the earth, to the west, beyond Africa and Europe, and which, it was proposed, should be called *America*, after its discoverer.*

The main object of this interesting map was to show where this newly discovered land was situated, and place it in its true position

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Another letter from same, February 26, 1879: * * "The planispheric projection in present use by the map-makers is only an improvement upon the one proposed by Hipparchus and explained by Ptolemy in a small treatise preserved to us through an Arabian translation. It is entitled '*Claudii Ptolemæi Sphæræ aplanetis in projectio in planum*,' and was first printed, though incomplete, in the Roman edition of Ptolemy, which appeared in 1507. The late French geographer D'Avezac, in his paper on the projection of maps, § 6, note 7, gives a history of this treatise, and expressed his intention to publish it with the full text, which he did not live to do.

This mode of representing the entire surface of the sphere within the compass of two circles, was again proposed as a novelty by the French mathematician Oronce Fine, in 1530, in his Cosmographia, which forms the fourth book of his Protomathesis. At the end of the book he briefly explains the projection, adding a large circular diagram to illustrate its construction. He does not, however, fill it with geographical details, but merely remarks '*that either half of the world may be drawn upon it*.' About the same time Fine was drawing a small map of the world to accompany the Paris edition of the Novus Orbis, in which he uses the double cordiform projection, which strangely deforms the outlines of the land, and is useless to sailors or geographers.

Not until near the close of the seventeenth century was the planispheric projection proposed for the third time, as a new one, by De la Hire, in which he was soon followed by others. Thus, a most valuable method of projection slumbered for nearly fourteen hundred years, unnoticed by geographers, whilst astronomers were using it for charting the heavenly bodies, and every astrolabe bore it in part carried out.

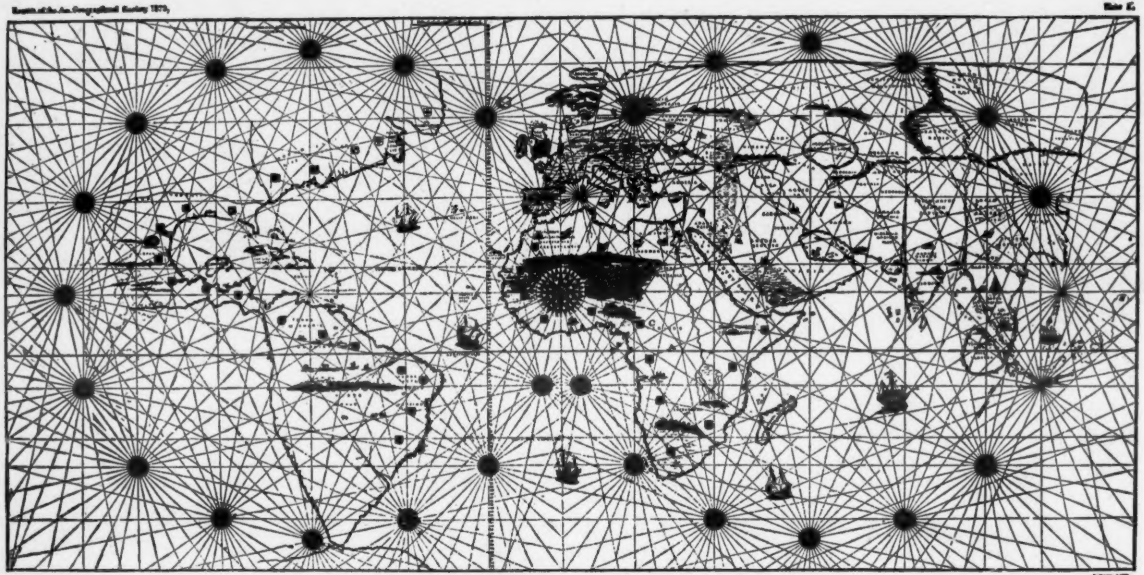
* Bartlett's Bibliotheca Americana, Part I, pp. 53, 54.

with respect to the whole globe. The map is but a partial or subspherical projection, being cut off at the 70th degree N. lat., and at the 40th degree S. lat. Within these limits it represents the half of the globe unknown to Ptolemy, or that half extending about 180 degrees west of the continent of Africa, so as to take in what Stobnicza conceived to be about one-half of the eastern part of Asia, and also some of the large islands lying south of Asia, such as Java, &c. The continent of America, north and south, is represented as running northwesterly to the centre of the map, and as extending from 70° N. lat. to 40° S. lat., the shape of the continent as then understood being evidently derived from a chart, not then published, which, from an inscription upon it, is supposed either to have been drawn by Columbus, or under his direction. The breadth and general shape of South America, though rudely given, is remarkably correct. The isthmus separating South from North America is laid down, but exaggerated in length ; and a small portion of North America is given, its extension to the west being left undefined. The position which the whole continent occupies as a part of the globe is, as would be expected, not correctly laid down, but as a conjectural representation of its exact position, the map was for that time (A. D. 1512) a very remarkable production. It is not only remarkable for the true scientific principles upon which it was projected, but for the geographical insight of its author in other respects. Columbus believed to the end of his life that the land he had discovered was a part of the continent of Asia ; and he had been dead but six years when this map of Stobnicza's was published. Stobnicza, better informed than Toscanelli or Columbus about the eastern part of Asia, and having evidently a correct idea of the true form of the earth, fell into no such error ; and in laying down the newly discovered continent as a part of the earth's surface, he placed it not far from the centre of the previously unknown part of the earth, and, as I have said, as extending in a northwesterly direction between Africa and Asia, with a large ocean separating the western part of it from Asia, or what we now know to be the Pacific Ocean, although the Pacific was not discovered by Vasco Nunes de Balboa until A. D. 1513, a year after the publication of Stobnicza's work.

I have dwelt upon this map, because it has not received geographers the attention it deserves ; and for the further reason

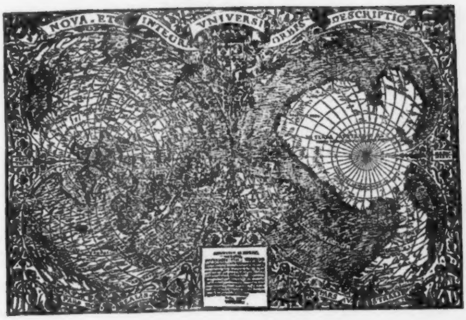
Apianus's Map, A. D. 1520.

Report of the Am. Geographical Society 1879, Plate E.

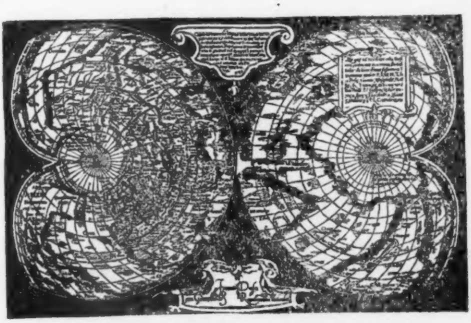


Reduced Copy of the Mapamundi drawn by HIERONIMUS DE VERRAZANO about the year 1529.

From Photographs of the Original, preserved in the MUSEO BORGIANO at the Collegio Romano de Propaganda Fide in Rome.



Oronce Fine's Map, A. D. 1531.



Mercator's First Map, A. D. 1538.

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that it furnishes a striking illustration of the slow progress of geographical knowledge; for the projection of maps of the world, upon the same scientific method, did not come into general use until about the beginning of the last century, or nearly two hundred years afterwards.

In 1520, Peter Benewitz, or as he called himself, Apianus, constructed a map of the world in the form of a heart, after the method of Sylvanus, but with the heart greatly extended from west to east, which has acquired a celebrity as the first map upon which the name of *America* appears.

In 1531 Oronce Fine undertook to improve this by a projection in the form of a double heart, so as to give, by that method, upon a plane or flat surface, both sides of the globe ; and in 1538 Mercator, then a young man of twenty-eight, published a map of this double heart projection, making many corrections, especially in respect to the continent of America, of which only one copy is known to exist, attached to an edition of Ptolemy of 1578, that belonged to Mercator, and which has been liberally deposited by a member of our council, J. Carson Brevoort, in the library of our society.

Simon Grynæus, in 1531, constructed a map of the world in the shape of a very broad oval, which will be found in the edition of his "Novus Orbis" of 1537; and this form having been adopted by Sebastian Munster in his Cosmography, 1541–1550, it became for a long time, through the influence of Munster's work, which had a wide popularity, and was in its time a great authority, the favorite mode of representing the earth.

All these maps, in their delineation of the outline of countries, were very defective, and especially in respect to the continent of America. The accessions to geographical knowledge had become so vast, and the details were so enormous, that the work of giving the whole of the surface of the earth, as far as known, with all the details of continents, oceans, gulfs, bays, straits, rivers, mountain ranges, and islands, with any marked approximation to correctness, was not accomplished until Mercator produced his great map of the world in 1569; which, when the fullness of its details is considered in connection with the new and scientific method upon which he projected it, entitles him to the appellation of the father of modern cartography. When it is contrasted with Munster's general map of

the world and his twelve maps of different countries in the edition of his Cosmography published ten years before, A. D. 1559, it shows how rapid at this time must have been the accumulation of geographical information and how great the industry of the man that could collect and arrange this vast amount of new material so successfully, and upon a plan so scientific. In this map he introduced what has ever since been known as Mercator's projection, which not only gave the world in one view, but by an ingenious and simple contrivance showed the most effectual way for a vessel to sail in a straight line over a curved surface, and thereby solved what was before one of the most difficult problems in navigation. That projection constitutes, down to the present day, the basis of every chart that is constructed to guide the mariner in his way over the ocean, and the map of the world on his projection is to be found in nearly every English or American atlas that has been published for a century and more, and yet the inquirer would search in vain in any work in the English language for the particulars of Mercator's life, or for any satisfactory account of what he did. How little is known respecting him, even by nautical men, will be sufficiently indicated when I state that, upon speaking about him not very long ago to a distinguished admiral, he looked at me and exclaimed, "What! was there such a man as Mercator? I always supposed Mercator's projection meant the merchant's projection."

But I do not propose to give an account of what Mercator did. That has been done already in the admirable paper read before this Society last spring by our Corresponding Secretary, Elial F. Hall, Esq., in which justice has at last been done in the English language, to a modest and laborious man of genius, to whom the great commercial and navigating nations of England and America have been indebted to an extent they have never appreciated, or at least never adequately acknowledged.

I have thus sought to bring together and arrange in something like consecutive order the principal facts in the history of cartography down to the time of Mercator. I have attempted to do this because, as far as I know, the facts have never been brought together as a whole. The state of cartography in the middle ages has been treated very fully by Viscount Santarem and by Lelewel, and to the researches of both these learned scholars I am indebted for much that has been stated respecting that period. I have not

brought the enquiry further down than the time of Mercator, because the progress of cartography since consists mainly in technical details, and is therefore not as important nor as interesting as the previous period. It is, moreover, easily ascertained. We have in the library of our society a chain of atlases from the first atlas of Ortelius in 1570 down to the present day, by an examination of which every step in its progress may be traced.

I feel very sensibly that I have undertaken a great deal in attempting to grasp so large a subject within the limits of an address like this—a subject in which the facts have to be drawn from a great variety of sources, and which are to a large extent fragmentary, so as to make it exceedingly difficult, in so limited a space, to group them together as a whole. I have made this attempt, however, in the expectation that some one who has the leisure, which I have not, will hereafter devote it to the production of a volume in which many details can be given that I have been compelled to omit, and which will throw all the light that research and critical investigation can now shed upon this interesting branch in the history of human progress.

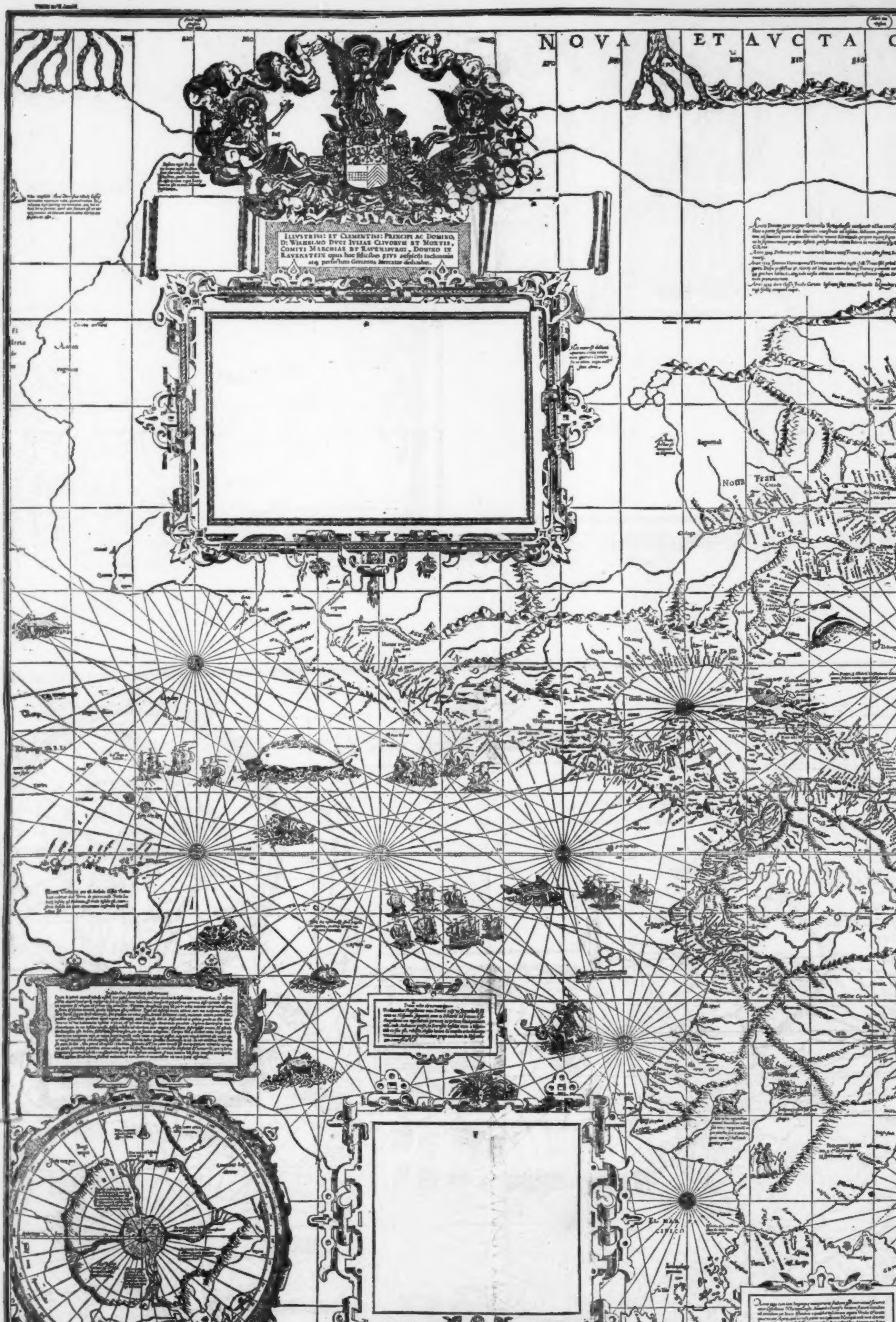
REMARKS OF J. CARSON BREVOORT, Esq.

At the close of the President's address J. Carson Brevoort, Esq., rose and said:

It is hardly necessary, before we disperse, to express the rapt interest with which we have followed our President throughout the essay he has given us, in lieu of his annual address upon the geographical work of the world. But I cannot let the occasion pass without saying that in the whole range of my own studies, which for many years have been directed towards the subject under review this evening, I have nowhere met with such a *resumé* of the History of Cartography. A few detached statements, gleaned mostly at second-hand, is all that is to be found in the so-called encyclopedias, while here the chain of progress has been conscientiously elaborated by original research.

While, therefore, moving that our President be awarded the grateful thanks of the Society for his able essay, I would add the hope, in which I am sure the whole Society will unite, that it may be preserved in a durable form and widely distributed.

The Rev. Dr. Roswell D. Hitchcock seconded the motion, which was passed unanimously.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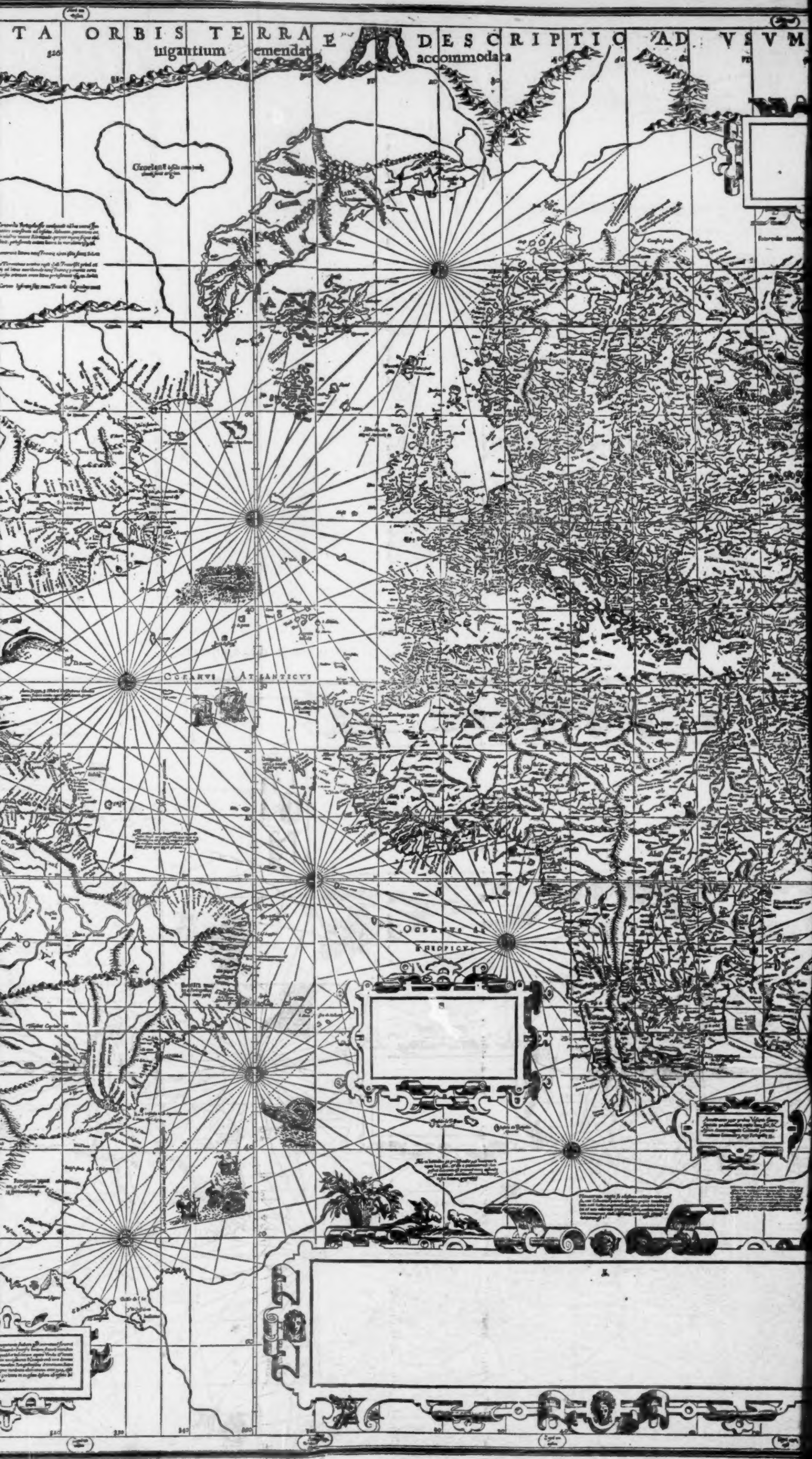
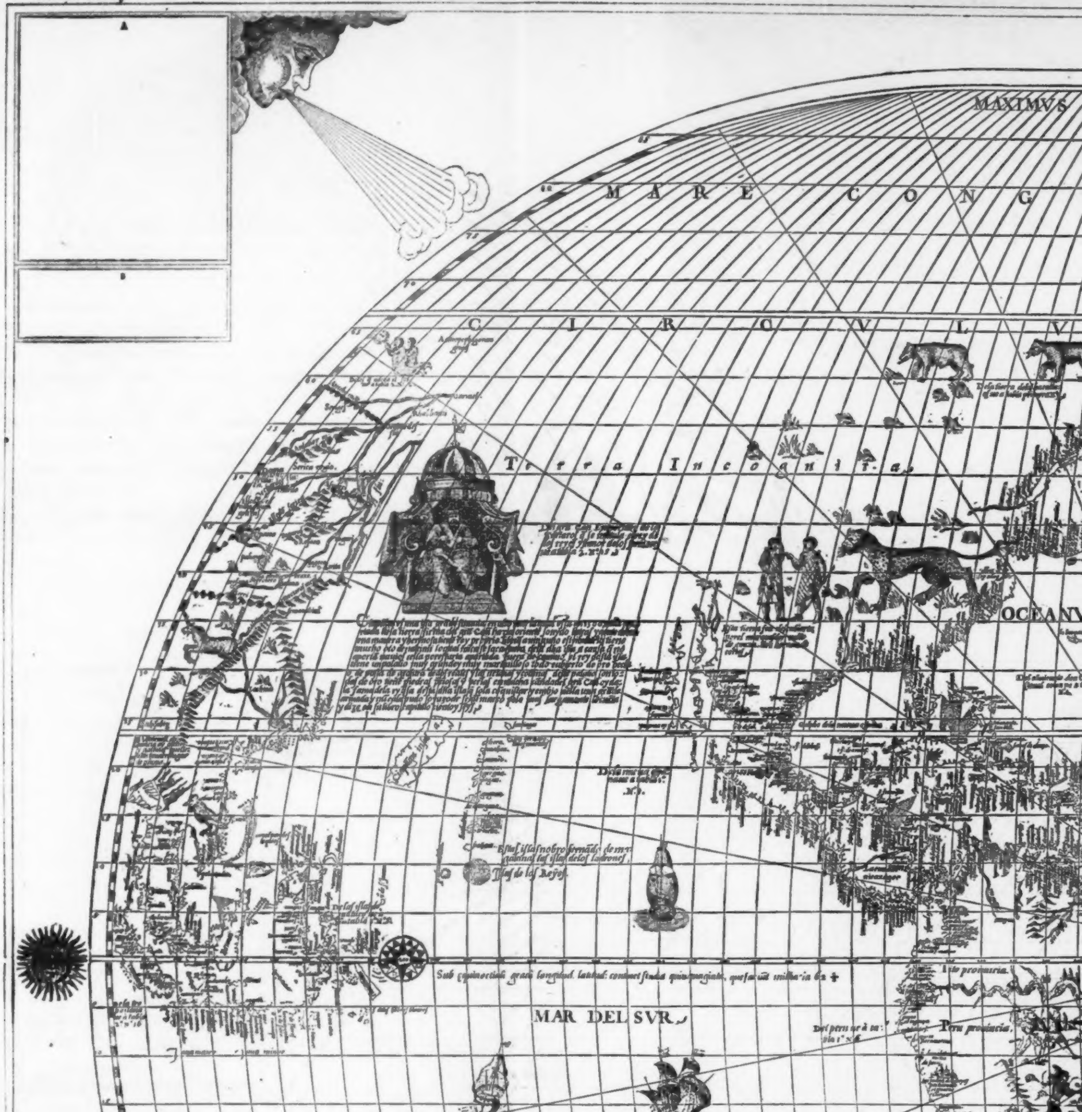


Mercator's Map of the World, A. D. 1569.

of the World, A. D. 1569.

p 38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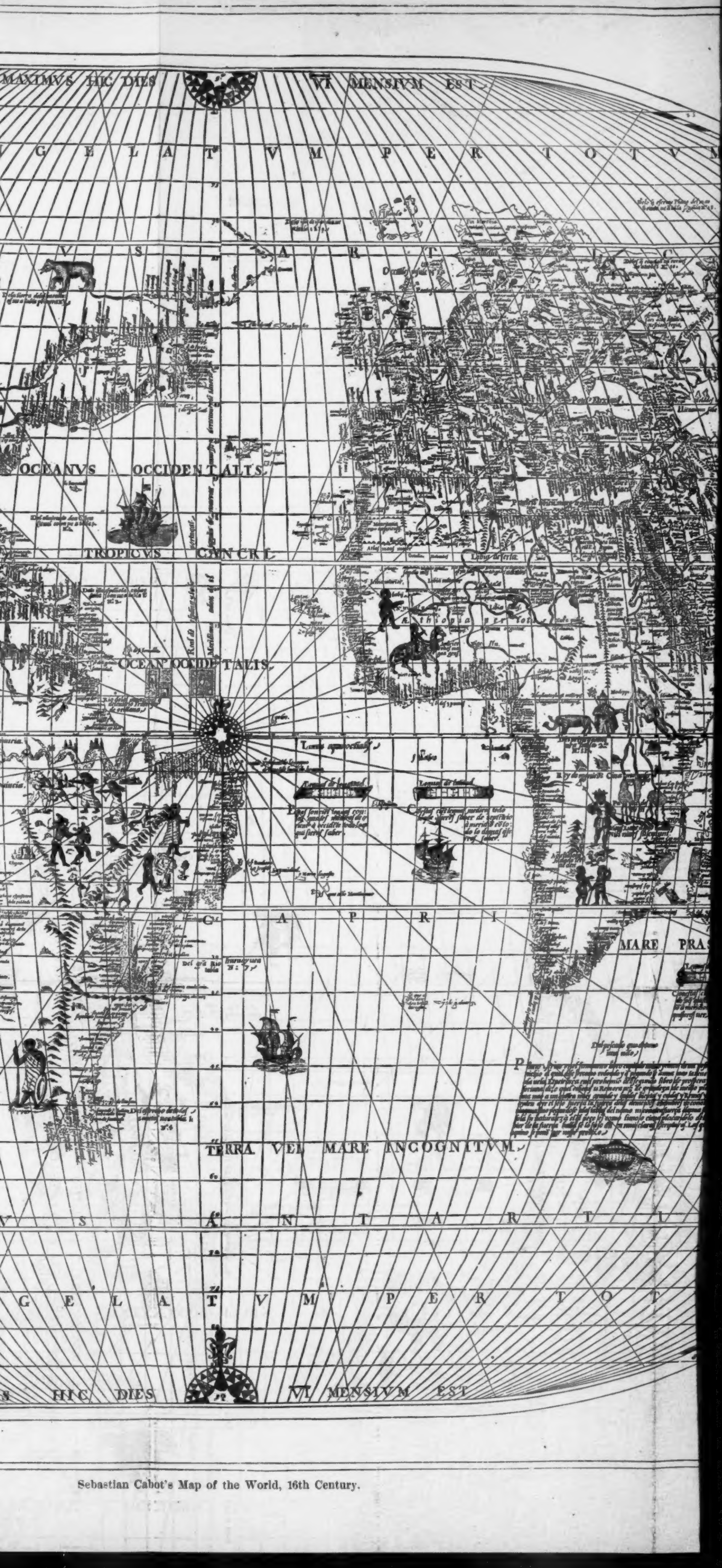

Sebastian Cabot's Map of the World, 16th Century.


Indicum pelagus.
MARE PRASSODVM
Libia deserta
Mare Rubru
OGNITVM
A R T I C V S
E R T O T V M
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LIST OF THE MAPS AND VIEWS EXHIBITED THROUGH THE STEREOPTICAN IN ILLUSTRATION OF THE ADDRESS.

1. The floating Earth, of Thales.
2. The Earth with roots, reaching down ward.
3. The Earth of the Vedic priests, supported by 12 columns.
4. The Hindoo symbolic conception of the earth, sustained by four great elephants standing upon an immense tortoise, floating in water.
5. The Chaldean idea of the earth, like a boat turned up-side down.
6. The Egyptian symbolical idea of the earth ; a recumbent female figure, with a goddess above, and a boat bearing the sun around the heavens, to illustrate its rising and setting.
7. Anixamander's cylindrical, or pillar-like form of the earth.
8. Plato's earth, in the form of a cube.
9. Homer's idea of the world.
10. Hecataeus's map of the world restored.
11. Map of Hipparchus, restored.
12. The Itinerary of the Romans, or painted roads.
13. Ptolemy's map of the world, from the edition of 1508.
14. Ptolemy's astronomical system.
15. Figure of Ptolemy, from an old map.
16. Cosmos's idea of the earth, with four walls.
17. Idea of the position of the heavens in the middle ages.
18. Edrisi's idea of the earth, like an egg floating in the water.
19. Arabian map of the 10th century.
20. Another of the same century.
21. Another of the 11th century.
22. Recently discovered Arabian map of the 16th century.
23. European map of the world, of the 8th century. Another of the 9th century.
24. Saxon map of the world, 10th century.
25. The Leipzic map of the 10th century.
26. Edrisi's map of the world, 12th century.
27. The Jerusalem and London Itinerary of the 13th century.
28. Another Itinerary map of the 13th century.
29. Map of the world, of the 13th century, in the Hereford Cathedral, England.
30. The St. Denis map of the world, of the 14th century.
31. Sanuto's map of the world, A. D. 1320.
32. Ranulphus Huyggden's map of the world, A. D. 1360.
33. A Portulan of Genoa, A. D. 1318.
34. The Catalan map of 1375.
35. Map of Andrea Bianco, A. D. 1376.
36. Marco Polo dictating his travels in prison.

AFGHANISTAN: THE PRESENT SEAT OF WAR, AND THE RELATIONS OF THAT COUNTRY TO ENGLAND AND RUSSIA.

BY MAJOR A. G. CONSTABLE.

It is a few days over forty years—indeed, it is just forty years and forty days—since I stood, one of a very thoroughly equipped, if not very large, English army, on the plains of Ferozepore, drawn up in full review order to receive a powerful Sikh Prince, with whom we wished to form an alliance. This Prince was a man about sixty years of age, and older in his appearance than his three-score might warrant. A life of constant intrigue, war and debauchery had bent his form, and withered what had once been a lithe and active frame. The great reception lasted for three days. On the first the chieftain was seated on an elephant, dressed plainly enough, excepting that the celebrated Koh-i-noor, stolen from the man whose cause he was now to join the English in espousing, blazed like a small sun from his sword arm, where it was fastened in a golden bracelet. I happened at the left of my troop to be very near his Majesty as he passed; and I could not help noticing that the one bright eye in his wrinkled and somewhat forbidding face took in at a glance every object; and every object there must have been strange and new to this Eastern despot. Words fail me adequately to describe the cavalcade which surrounded and followed him. His escort were mounted on superb horses, the riders covered for the most part with the brightest gold, steel and silver-linked armor. Accustomed as we were to the gorgeous displays of the native chiefs of British India, the concurrent expressions in our mess-tents in the evening were to the effect that there never had been seen a handsomer, more richly-dressed, or more soldier-like set of men than surrounded this old warrior on this occasion. This splendid monarch was the famous Runjeet Singh, the Maharajah, or King, of Lahore.

It is not necessary to my purpose this evening to describe in greater detail the meeting between the Sikh monarch and the Earl of Auckland, Governor-General of India. Enough that I should tell you that they were met there to arrange definitely for the invasion of Afghanistan, there to dispossess Dost Mahomed Khan, the reigning Ameer at Cabul, and to restore to his throne Shah Soojah, who, nearly 30 years before, had been driven from it by his own brother, Mahmoud, a weak and dissolute man, who proved no more than a puppet in the hands of his vizier, Futteh Khan, the head of the Barukzyes, one of the two great families of Afghanistan—the other being the Suddozyes, the head of which was the deposed Soojah. Futteh Khan was the eldest of twenty brothers, by various mothers—the youngest of the twenty being Dost Mahomed Khan, whom the English were now about to dethrone.

The story of the great Dost's rise to power is a true Eastern romance. He began life as a sweeper at a sacred tomb, but obtained the favor of his powerful brother, who, though nominally only the Vizier or Prime Minister, was actually the ruler of the country, by killing in the open street, when only fourteen years of age, one of the Minister's most powerful enemies. Dost Mahomed Khan was a born ruler of men, and soon showed what metal there was in him when his great brother was seized by Prince Kamran, son of the reigning Ameer, who caused him to be cruelly murdered, after having himself put his eyes out with the point of a dagger—a brutal act, which overthrew the long-tottering dynasty of the Suddozyes, who had been kings in Cabul since Ahmed Shah founded the Afghan Empire, in 1747. Dost Mahomed's vengeance was sudden and no less brutal. It would not avail us to enter into the story of his rise to the chief seat of power. Enough to say, that in 1838 he nominally ruled over the whole of Afghanistan, with the exception of Herat, where Kamran, the murderer of Futteh Khan, still reigned, the last remnant of the legitimate line, save the exiled Soojah, a fugitive in British India, who, with his eldest brother, Shah Zeman, a blind old man, was supported by the bounty of the English.

In mentioning Herat, I have named the place which was the real cause of the great gathering at Ferozepore, and the ill-starred alliance between the English and the Sikhs. A glance at any good map of the northwestern frontier of Hindostan will show that this

place, Herat, is correctly styled the gateway of India. All the great invasions of India have taken place by armies passing to the southward of Herat, through the Bolan Pass, on to the plains of the Indus. So it came to be the firm belief with every Governor-General of India and his Council that it was of paramount importance to the safety of the British supremacy in India that this gateway and its keys should be in the possession of a power friendly to the British.

So far back as the beginning of the century, fears had been entertained that Napoleon, in alliance with Alexander of Russia, would, by the connivance, if not the active assistance of the Persians, pour into India a well-disciplined army through this oft-trodden path. A mission, at an enormous outlay of money, had been sent to the Persian monarch's capital, with substantial inducements to the Persians to refuse to permit of any such invasion. Accordingly the Emperor of Persia entered into an alliance, offensive and defensive, with the British. Of what value this treaty might really have been to the English, it is needless now to inquire, for soon after it had been negotiated an event took place which removed the immediate cause of danger against which it was intended to provide. The story of the rupture between Napoleon and the Russian is too well known to need recital here.

One article of this Persian treaty, however, is worthy of notice. It was to the effect that in the event of war arising between India and Afghanistan, Persia should invade the latter at the cost of the former.

The English were not content, however, and very wisely not content, with making provision against a possible *Afghan* war alone. They felt that there would be at least equal danger to their Eastern Empire from a *Persian* war, should the Shah at any time take up the sword against them. So the Indian Government, in 1808, sent Mountstuart Elphinstone on a friendly mission to the court of Cabul. The English envoy was not allowed to penetrate into the country, however, being met at Peshawur by the reigning Ameer, Shah Soojah, who received him in royal state, seated on a golden throne blazing with jewels, chief of which shone forth in a gorgeous bracelet, the mighty Koh-i-noor—magnificence which, great though it was, did not outshine the English, for the entire mission was on a scale of profuse splendor, lavishing costly presents

as if they were pebbles. Shah Soojah was very friendly, and bound himself to treat any nation in alliance with Persia much in the same way as the Persian monarch had promised to treat the Afghans.

Moscow and Waterloo removed all fears of a French invasion of India, but in its stead slowly, and like a huge nightmare, arose the shadow of Russia. Shadowy the danger to India might appear, but it was an actual presence to one of her neighbors, for the annexation of Georgia to the empire of the Czar brought the eagles of Russia to the frontier of Persia. For many long years the Persians appear to have existed in daily dread of their great northern neighbor, until in 1826 Abbas Mirza, heir to the Persian throne, threw down the gauntlet to Russia, and was badly whipped for his temerity.

The treaty to which I have just alluded bound England to help Persia when the latter should be involved in war with any European nation; but at the critical moment this help was not forthcoming, and in 1828 all that Great Britain cared to do for her quondam ally was to induce her to conclude a humiliating treaty with the Czar, by which Persia lost two provinces and practically her whole defensive frontier to the north. In the words of an English author, Persia was delivered, bound hand and foot, to the court of St. Petersburgh. The territory thus acquired by Russia was nearly equal in extent to the whole of England, and her outposts were brought within a few days' march of the Persian capital.

Futteh Ali, then Emperor of Persia, was, in spite of their faithlessness, faithful to his English allies; but the Russians had found means to sow the seeds of enmity against the British in the breast of Mahomed Shah, who ascended the Persian throne in 1834, a firm friend and ally of the Russians. He believed that with their assistance he could extend his empire to the east, thus indemnifying himself for the northern provinces lost by the stupidity of his own father, Mirza. He had long dreamed of recovering Herat, lying to the east of his dominions, which had been formerly a part and parcel of them, and he now made a determined attempt to realize his dream. He laid siege to Herat. It was well understood in India that this siege of Herat by the Persians was encouraged by Russia. Indeed, the English Minister of Foreign

Affairs said, in a letter to Count Nesselrode, that while the British envoy at Teheran was endeavoring to dissuade the Shah from such an enterprise, the Russian envoy was giving advice of an opposite tendency; while one was preaching moderation and peace, the other was inciting to war and conquest ; and whilst the one pointed out the difficulties and expense of the enterprise, the other inspired hopes of money and assistance. While a Russian agent was doing this at Teheran, another Russian agent was guaranteeing a treaty injurious to British interests between Mahomed Shah and the Sirdars or Chiefs of Candahar. At this critical juncture also a Russian agent, Vickovich, appeared at Cabul, endeavoring by the most lavish promises to deter Dost Mahomed from allying himself with the British, desiring him to look for support to the Persian king and his Russian backers.

The fate of this Vichovich was truly Russian. On his return to St. Petersburg the protests of the British had affected the memory of Count Nesselrode, who, on receipt of his agent's card asking for an audience, indignantly refused to see him, saying that he knew no *Colonel* Vichovich, only having heard of a mercantile adventurer so called. The unfortunate man understood the meaning of this, returned at once to his lodgings, destroyed his papers, and then himself, by blowing out his brains.

To counteract this attempt to establish Russian influence in Afghanistan, the Indian Government had despatched to Cabul an envoy in the person of Alexander Burnes, who had some years before passed through that country as a private traveller. Whatever might have been the real purposes of the Indian Government, their envoy was so hampered by instructions that his mission was a fruitless one, as he himself well knew it would be when starting on it. He was instructed to demand from Dost Mahomed Khan the dismissal of the Russian envoy, with a refusal to hold any official intercourse whatever with the Russian people. In fact, the Dost was required to give up all friendly intercourse with any other people than the British, in return for which the English envoy was instructed to promise that the English would very kindly regard the Afghan ruler, who must be content with their bare recognition. The English would give or promise nothing more. Of course Burnes's mission ended as a farce.

While Burnes was vainly endeavoring to persuade Dost Mahomed

that British smiles were worth more to him than Russian gold, the siege of Herat, in the western part of Afghanistan, was vigorously pressed by the Persians. That Herat did not fall into the hands of the Shah, was mainly due to the accidental presence of a young English officer, Eldred Pottinger, who assisted the Afghan ruler and his astute, but wily and unscrupulous, minister, Yar Mahomed, to withstand the Russian forces. Oddly enough, while an English officer had thus charge of the defenses, the British and Russian envoys were both in the besieger's camp, the one begging the Shah to withdraw his forces, and the other with promises and ready money encouraging the Shah to persevere. In an evil hour some of the Persian officials insulted the English envoy, who sent to Bombay for a naval force, to descend upon the coast of Persia, to take vengeance for his insulted dignity. The force sent was absurdly small, but the appearance of two regiments of English redcoats at Karrack was a hint which the Shah was prompt to understand, and, to the amazement of the besieged, not less than to their intense relief, the Persian army retreated from before Herat, the position they had occupied eighteen weary months. Herat was thus saved from falling into the hands of Persia.

As I have said, the district of Herat was held by a Suddozye chief, a relative of Shah Soojah, who was to be restored to the throne of Cabul by the aid of British bayonets, assembled at Ferozepore and elsewhere. Time will only permit of a glance at the story of the invasion of Afghanistan. Sufficient to say that the meeting between the English viceroy and the Sikh monarch I have already described, resulted in a tripartite alliance between these two parties and Shah Soojah, the claimant to the Afghan throne, upon which war was declared by the Indian Government.

Entering the country by the Bolan Pass in the west, the English rapidly occupied Candahar, Ghuznee and Cabul. The fall of Ghuznee, supposed to be the strongest fortress in the country, so disheartened the Afghan chiefs that they deserted the standard of Dost Mahomed, and flocked to offer their submission to the British. Dost Mahomed Khan fled across the Hindu Koosh, where he hoped to gather followers who could and would resist the British. His hopes were vain. Treachery and bribery were too strong for him to resist, and one evening, when the

British resident at the court of the new ruler, Shah Soojah, was taking his daily ride, he was surprised by the appearance of two solitary horsemen, more strange, if more real, than any of G. P. R. James's famous horsemen, one of whom riding up to McNaghten, the resident, tendered him his sword, acknowledging himself to be Dost Mahomed, and asking only that he should be shielded from the vengeance of his triumphant rival. McNaghten, like every other person who ever came in contact with the Dost, was very much struck by the noble, simple bearing of the fallen chief, and received him with every proper kindly expression. Dost Mahomed was subsequently sent, a prisoner of state, to Calcutta, where he lived a quiet and retired life for a couple of years, gaining the respect and good-will of every one, until the exigencies of the State compelled the British Government to send him back as a ruler of his people.

It had been hoped by Lord Auckland, that when once Shah Soojah should be seated on his throne, the English troops could be withdrawn and he left to the care of his own subjects. This hope proved a sad delusion. The fickle Afghans, glad as they were to turn out the great Baruksye Sirdar, were far from inclined to accept Soojah in his place. But there was such a general appearance of tranquillity throughout the country that McNaghten, believing what he wished to believe, that Soojah had really a place in the affections of his people, allowed part of the English forces to return to India. While the garrisons were thus weakened, Akbar Khan, son of Dost Mahomed, was plotting against Shah Soojah and his English allies. McNaghten had been created a baronet and appointed Governor of Bombay, and on the very day fixed upon for his departure to the British provinces, a rising took place in the city of Cabul, in which Burnes resided. Burnes and his brother were massacred. McNaghten upon this entered into negotiations with Akbar Khan to retire with all the British troops from Cabul to Peshawur, Akbar Khan agreeing to give them safe conduct through the mountain passes of the Khyber. Immediately after this treaty was made, Akbar Khan invited McNaghten to meet him in his tent for a final conference. McNaghten went, accompanied by three officers of his staff. The two great men retired to confer alone. Angry words were heard to pass. A

pistol shot rang out, and in an instant the lifeless body of the English envoy lay quivering on the sands. The same moment the three attendant English officers were seized by men standing behind them. Tied with cords, they were placed on horses, each still held by the strong arms that had bound him, and carried from the scene at a rapid pace. One of the three managed to release himself and alight on the ground, only to be cut to pieces by the enraged multitude. The other two were carried off to a place of safety and finally returned to India.

Various reasons have been assigned for this monstrous act. It was believed at the time by well informed persons in India that Akbar Khan had that morning been put in possession of positive proof that, while McNaghten was treating with him for the peaceable evacuation of Cabul, he was inducing certain hill tribes, by a lavish promise of English gold, to seize the person of Akbar Khan himself. It was asserted that he had produced this proof to McNaghten, and then slain him with his own hand. In Afghan morality, this bloody act was simple justice. After the death of McNaghten and Burnes, the chief direction of the English defense fell upon General Elphinstone, an old Pall Mall dandy, as brave and incompetent as any man that ever lived. Again, time will not allow me to enter into details of the retreat of the British forces. Suffice it to say here, that the oft-told story of only one man having escaped to tell the horrid tale to the garrison at Jellalabad, is not correct. Akbar Khan took personal charge of all the sick and wounded officers, all the women and their husbands, who were in garrison in Cabul. They were prisoners, of course, but they were treated as well as their captor's straightened means would allow, and I may say here that when the avenging armies of England, under Pollock and Nott, entered Afghanistan, they were all rescued in sound health, travel-stained and weary, excepting the poor old General, who had died, the worn out with gout and old age.

The English invaded Afghanistan in the spring of 1839, and made a grand triumphal entry into the capital, Cabul, in August of the same year. On the 6th of January, 1842, the fatal march through the Khoord Cabul Pass commenced.

In June, 1839, two months before Shah Soojah entered his capital, under British escort, old Runjeet Singh died, and nine years later the country over which he had ruled became incorporated with

the British Dominions. His descendant, the Maharajah Dhuleep Singh, is in the enjoyment of an enormous pension—a quarter of a million dollars per annum, living the easy life of an English country gentleman, keeping his pack of hounds, and hunting them with courage and discretion. I believe he is considered a Royal personage, and entitled to all the privileges and immunities that distinction implies. Verily, the days of romance are not passed! How that one eye of the old Lion of the Punjaub would glare at a descendant of his riding to hounds in an English county, dressed in the orthodox scarlet and top boots, and I who am talking to you, and not yet an old man, have witnessed these changes.

Shah Soojah was murdered soon after the English were driven from Cabul, and Dost Mahomed Khan was restored to his throne in the same year, 1842. He reigned peaceably, and, so far as the English was concerned, honestly and justly, until his death in 1863.

The virtual extermination of the British force in Cabul was a stunning blow to the English in India, but they soon recovered from its effects, thanks to the courage, intrepidity and decision of the officers of the Indian army. Civilians might talk of evacuation, and final withdrawal, but soldiers said "No; not until our comrades are avenged and our prisoners rescued!" The defense of Jellalabad by Sir Robert Sale, and of Candahar by Gen. Nott; the gloriously triumphant converging marches of Nott and Pollock, and their gallant and soldierly assumption of the responsibility which the Governor-General threw upon them; the march into Cabul, and the rescue of the English prisoners from beyond the Hindu-Koosh, are all parts of a story which I should love to tell, if time allowed. They form one of the most glorious pages in English history.

An invasion of Hindostan in the present day is no idle fear; what *has* been, *may be*, although truly the condition of the country is very different under the powerful rule of a warlike and wealthy nation like the British, to the state of things when she was an easy prey to any of her northern neighbors who cast longing eyes upon her treasures. The first invasion is supposed to have occurred B. C. 518, when the king of Persia, Darius Hystaspes, crossed the Indus, with the fatal result for India of a great increase of his revenue, and from that time dates the unhappy renown of India as a land of fabulous wealth, meaning, really, a land which might be easily plundered. The Afghan Mahmoud of Ghuzni, A. D. 1000

to 1024, made twelve expeditions against the cities and temples on the plains of India.

Two hundred years later, Genghis Khan, at the head of his Tartar and Scythian hordes, followed in the footsteps of Mahmoud. After Genghis, at an interval of nearly 200 years—that is, in 1398—Timour the Tartar, or Timour Leng, as he was styled from his lameness, or Tamerlane, as we call him, penetrated to Delhi, which, after capturing, he gave up to rapine and pillage. It is said that every soul above fifteen years of age was ruthlessly butchered by his rabble soldiery.

Timour did not remain long in Delhi; he returned to his home in Samarcand, and India was free from invasion for a century and a quarter, when Baber Khan of Bokhara, descended from both Genghis Ghan and Timour, in the year 1526, at the age of 42, led his conquering hordes to Delhi, where two years later he firmly established himself, founding the Mogul dynasty, the last remnants of which were swept away like old rubbish when the avenging army of England, twenty years ago, captured Delhi, after it had been in possession of the mutineers of the Bengal army for several months.

Baber's was not the last invasion of Hindostan.

Nadir Shah, king of Persia, swept through the land only 150 years since, but when he retired, laden with the spoils of a hundred cities, the Koh-i-noor diamond and the Peacock throne being part of the plunder, the land was again to be laid waste by his successor, Ahmed, who on three several occasions led his Afghan hordes to Delhi. After the last great battle at Paniput, the victorious Ahmed appears to have been satisfied, and retired to his Afghan capital.

I would here pause to remark that in the year when Ahmed last sacked Delhi, the English Clive won the battle of Plassy. As a recent writer has remarked, at Plassy the first step was taken in stemming those terrible waves of conquest which had only plunder and cruelty for their object.

So we see that the first and last of the invaders were Persians; and be it remembered that each of these conquering armies had passed through the Afghan defiles and across the River Indus. Where then is the stragetical frontier of British India? I think the English are about to settle this by the permanent occupation of the interior of these famous passes.

We are apt to think of Afghanistan as having natural bounda-

ries, the same yesterday, to-day, and forever. The sketch of conquest I have just given proves the historical reverse; for instance, Mahmoud of Ghuzni ruled from Ispahan, in Persia, to what is now Lahore, in the Punjaub; Tamerlane, from Samarcand, now Russia, to Delhi in the plains of India. You have heard how little account was made of vast distances and natural obstacles; how Afghanistan was not a frontier, or barrier for a frontier, but actually the centre of great empires.

Let us now take a brief survey of the country. Afghanistan bounded on the North and East by immense mountain ranges and on the South and West by vast tracts of sandy desert opposes to external hostility natural defenses of a formidable character. The general aspect of the country is wild and forbidding, but not unwearied by spots of gentler beauty in the valleys and on the plains. The towns are few and far between, the people, or rather the inhabitants—for in our sense, as a people, as homogenous, there is really no Afghan nation—the races there, or the group of races, are hardy, vigorous mountaineers: the score of tribes are all alike in their characteristics, brave, independent, but of a turbulent, vindictive character; they are only happy when fighting; since they have been known in history, they have lived in a state of chronic warfare. Civil war has a natural tendency to perpetuate itself, and among savage tribes, blood is always crying for blood. Revenge is a virtue among them, and like the Corsican vendetta, retribution passes from father to son, and murder becomes a solemn duty. An Afghan is either a soldier, a farmer on a small scale, or a shepherd; never a trader—trade is left in the hands of Hindus or other aliens.

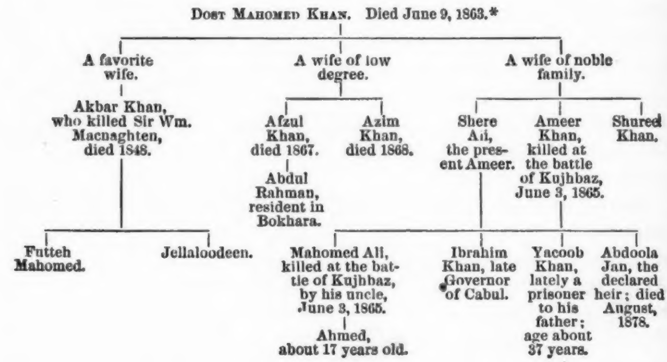
These mountaineers have certainly redeeming traits. They are of a cheerful lively disposition, hospitable and generous; a stranger is always welcomed, and even a deadly enemy is safe under an Afghan's roof.

According to Russian estimates the various tribes could, if united, turn out 250,000 warriors, but then they never are united.

I will not detain you by any account of these tribes—the mere roll of names would be very tiresome; but I most confidently refer you for all such information to a *brochure*, recently prepared and published in this city, by two brother officers of my old and dearly loved regiment, Captains Jackson and Wyndham, the last named being the friend who has kindly consented to assist me this evening in

explaining the map and the views which will be presently thrown on the screen.

For a correct understanding of the present difficulties between the English and the Afghans, or rather the Afghan chief, Shere Ali—for the English protest that they have no quarrel with the Afghan nation—I would draw your attention to the genealogical chart now spread before you.



It is not necessary that we go further back in this genealogy than to Dost Mahomed Khan, to whom so many references have been made. At his death in 1863, Dost Mahomed by his will left his throne to his fourth son, Shere Ali, setting aside the claims of the elder half-brothers, Afzul Khan and Azim Khan. These men were not inclined to submit, and rebelled. Afzul was captured and imprisoned. After their defeat, Shere Ali's younger brother, Ameen Khan, tried his hand against the Ameer, and at the battle of Kujhbaz, in 1865, he killed with his own hand Mahomed Ali, the Ameer's eldest and favorite son, and was in his turn slaughtered by that Prince's followers.

Afzul Khan's son, Abdul Rahman, had escaped to Bokhara, and there married a daughter of the chief of that country. On the death of his uncle Ameen, he returned from Bokhara, and was joined

* From "Afghanistan, and the Relations of that Country to England and Russia." By A. G. Constable. Published by Harper & Brothers, New York.

by his other uncle, Azim. After several severe battles, Shere Ali was defeated in May, 1866; Afzul was released and declared Ameer. Shere Ali took refuge in Herat, where his son Yacoob commanded. A year afterwards Afzul Khan died, and was shortly after followed to the Moslem paradise by his brother Azim Khan, and then Shere Ali won the position he has ever since retained, and won it in a great measure by the warlike capacity of his son Yacoob. Abdul Rahman had fled beyond the Oxus to his father-in-law, the Ameer of Bokhara, where he has since resided, a pensioner on the bounty of Russia. It is said that Gen. Kauffman, the Russian Governor-General of the Khanates, gives him fifteen thousand dollars a year. This man is, therefore, one of the main factors in the present state of affairs, as he may be used as the Russian *protegé* to the throne of Cabul, on the ground that his father, Afzul Khan, was the rightful successor to Dost Mahomed.

Shere Ali has always held it as a grievance against the English Government that they did not support his claims to the throne at the time of his father's death, but that, on the contrary, when his brothers Afzul and Azim had successively held the capital of Cabul, the English Government had recognized them in turn as *de facto* rulers. When he had firmly seated himself on the Musnud, he felt that he owed no gratitude to his southern neighbors; nevertheless, at the famous conference with Lord Mayo at Umballa in 1869, he tried to persuade his Lordship to recognize his youngest and favorite son, Abdoolla Jan, as the legitimate heir to the throne of Cabul, asking in plain terms that, if necessary, this succession should be supported by men and money, a request which was positively refused. But this was not Shere Ali's only grievance, for in 1870 Yacoob Khan, the elder son, understanding that Abdoolla Jan was declared heir, rose in rebellion against his father, and it is said, with what truth I do not know, that this rebellion was countenanced by the English authorities, and that they even talked of adding Candahar to the rebel son's lieutenancy.

After the rebellion of 1870 had collapsed, Yacoob fled to Persia, and in the year following, assisted by the Persians, Yacoob again took possession of Herat. A kind of peace was then patched up between father and son by the personal influence of Lord Mayo, and in September, 1871, he returned from Cabul, where he had been visit-

ing his father, to Herat, as Governor, but with a strong body of his father's personal adherents surrounding him. These men kept Yacoob in a constant turmoil with Shere Ali, reporting to Cabul everything which might appear disadvantageous to him. It is said that after Abdoolla Jan's formal nomination as heir in 1873, Yacoob intrigued with the Persians and Turcomans, and it is even asserted that he sought help of the Russians against his father, but he met with no success. In 1874 he was again summoned to Cabul, but, suspecting treachery, demanded a safe conduct, which was granted. His fears were not ill-grounded, for on his arrival he was at once placed in confinement. The Indian Government interceded with the Ameer to spare his life. This interference was successful, but it is said that his imprisonment, which lasted until recent events compelled his father to release him, has been so rigorous and harsh that his intellect has suffered. Ayub, his younger brother, when Yacoob went to Cabul, fled to Persia, where he has ever since resided. While this was the state of things in Afghanistan, the Russians had been slowly working their way towards the Afghan provinces beyond the Hindu-Koosh, and in 1873, at the time of the Russian attack on Khiva, Shere Ali sent an envoy to Simla, to lay before the English Governor-General the fears which he reasonably entertained as to the ultimate aims of Russia. The envoy was met by Lord Northbrook with the statement that the Ameer's alarm about Russia was premature; that his demands as to the nature and extent of the assistance to be rendered by the English were extravagant, and that in fact the whole course of the policy which he desired to initiate was calculated to provoke rather than avert the crisis which he dreaded. The Ameer thought differently. If he could not secure an English guarantee against Russian invasion, it was natural that he should turn to Russia for a guarantee against English aggression. He foresaw, or thought that he foresaw, that there must ultimately be collision between England and Russia in Central Asia; that he must therefore make his choice between the opposing forces, and cast in his lot with one or the other. He did all that the English could reasonably ask. He offered them the first chance, but that beggarly policy which has come to be ironically known by the term "masterly inactivity" ruled the hour, and it was then that Shere Ali began seriously to entertain the hope

of making Russia his friend, in place of England ; and so commenced a series of discourtesies to England, which culminated in the refusal to receive the embassy headed by his own personal friend, Sir Neville Chamberlain, which, as we know, was not allowed even to enter the country. The real difference between the English policy and the Afghan is simply this—that the Ameer would have liked to put his own country in a state of defence against any possible Russian aggression at the cost of England, but he would not allow those defences to be undertaken or superintended by English officers not under his immediate orders, which was one of the conditions on which alone the British authorities would give him the benefit of their powerful co-operation. Shere Ali has all along had a dread—and a very righteous dread, too—of sinking his sovereignty and accepting the position of a prince protected by a foreign government, really fearing that Afghanistan would be absorbed into the Indian Empire; and so it came to pass that when he was finally satisfied that he could obtain English aid only at the expense of his independence, he courteously received the Russian envoy at his capital, while refusing to permit the Englishman to enter his dominions.

And now I have brought this hasty and necessarily very imperfect sketch down to the present day. It may be asked, what right has England to invade Afghanistan because the chief of that country preferred the alliance of Russia to that of England? I answer, the right of self-preservation. England has assumed the protectorate of two hundred and fifty millions of people, and it is her bounden duty to see that they do not suffer by any wave of conquest similar to those which afflicted Hindostan for so many hundred years. What would it advantage the people of Hindostan to change English for Russian rule? The Russians govern with the iron hand of military power. The English government of India is based on civil law, right and justice, although sustained by mighty strength. The great feudal chiefs of India, Hindu and Mahommedan, understand this difference between English and Russian rule, and are showing it by the support they give to the local government in the present war. With our knowledge of the facility with which Russia could, in alliance with Persia and the Afghans, enter the plains of India, surely we may concede that it is the paramount duty of England to take every precaution against such a result.

Persia has lain for many years prostrate at the feet of Russia. The Shah-in-Shah is merely the henchman of the Russian Czar. Even if time allowed me, I should not enter upon any history of the advance of Russia through Asia, because, I am happy to say, before long this society will have the advantage of listening to a gentleman far more competent than I can pretend to be to instruct and interest them on this subject. But I may say that a very large force of Russians is now, and has been for some years, within a few weeks' march of the northern passes into Afghanistan. During the past year, when there was every appearance of an armed collision between England and Russia, there is no possible doubt that the latter country had taken measures to avail herself of the position she had gained on the frontiers of the British Empire in the East. It is asserted by Sir Henry Rawlinson, the most competent authority in England, that General Kauffman, the Russian Governor-General in Central Asia, had made every preparation to move upon Afghanistan. Three army corps were prepared to move upon the Oxus, the dividing line between Turkestan and the northern provinces of the Afghan. The main column, under Kauffman himself, marched from Tashkend through Samarcand to Djam, the extreme point of Russia's frontier to the south, a right flanking column ascending the Oxus from Petro Alexandrovsk, twenty miles above and opposite Khiva, to Charjui, the point at which the river is crossed by the high road from Bokhara to Merve. A left flanking column was to follow the course of the Kuzil-zu [Red River] from Samarcand to the Afghan town of Kunduz. This is believed to have been the programme. How much was actually accomplished is not known. It is only certain that the main column under Kauffman remained at Djam for some weeks, waiting orders to advance to Kilif, the main passage of the Oxus into Afghanistan. Thence they expected to have an unobstructed road through Meymeneh to Herat, the objective point of so many expeditions, hoping, it would appear, to keep open their communications with their base by a simultaneous occupation of Merve by the column from Charjui on the one side, and by a large force under General Loumakin, gradually pushing its way eastward from the Caspian, on the other. This last-named force Rawlinson believes is, in all probability, still bent on reaching Merve. The

success or failure of the attempt must greatly, if not wholly, depend upon the Persian Government and its recently formed allies, the Aktals and Tekkeh Turcomans.

These Tekkehs are the most warlike of the Turcoman race, and are settled, if a nomadic people can ever be called settled, along the River Attrek and the skirts of the hills from the Caspian to Merve ; they number 60,000 tents, or—five persons to a tent—300,000 souls. If they are brought under the influence of Russia they, with the Salor and Saruk tribes, could readily furnish a force of 50,000 men, which, under Russian officers, would be the most formidable light cavalry in the world. Appearances at present, however, are, that the King of Persia is himself trying to induce these very Turcomans to become his allies and friends. However, there is no accounting for Persian policy, which has always been marked by the extremest duplicity, and the latest intelligence is, that the Shah has despatched a considerable force into Seistan, nominally to punish a refractory chief; but there is a strong suspicion that this force is to be used in preventing the entrance into Persia of fugitives from the banks of the Attrek, as the Russians under General Loumakin move along that river. The Russian journals of recent date make no secret of Kauffman's intention to occupy the oasis of Merve, if he can reach it. He can only do so by the connivance of Persia and the consent of the Tekkehs. Once at Merve, the Russians are within ten easy marches of Herat.

Whether the Russian policy is really antagonistic to the English rule in India or not, it is, as I have said, impossible for the Indian Government to shut its eyes to the possibilities of a Russian, Persian, Turcoman, and Usbeg force marching on Herat. We all know the steps which England has taken to prevent the present consummation of any such plan, if plan there be. We know the English forces have entered Afghanistan through the Bolan, the Peiwar, and the Khyber Passes; that they are settled in winter quarters at Jellalabad, Ghirisk, or Candahar. We hear that Shere Ali has left the defense of his capital to his warrior, but long captive son, Yacoob; one report locating the Ameer himself at Herat, with a strong force under his command; another stating that he has fled to seek aid and comfort from the White Czar in St.

Petersburgh; and, finally, that when there he will ask for a European Congress (like that lately held at Berlin) to decide the dispute between himself and the British. This may be so, for there is nothing too marvellous for the Ameer to undertake in his desperation.

I close by expressing a belief that, in spite of Czars and Conferences, the English have this time entered Afghanistan to remain there, occupying not the whole country, but in all probability a line stretching from Ghirisk on the West to the passes into Cashmere ont he East, having a force at Chitral checkmating any contemplated advance of the Russians through Kashgaria.

FIRST LINE THROWING EXPERIMENT IN THE UNITED STATES, APRIL, 1849.

THE PRESERVATION OF LIFE AT SEA.

By Lieutenant T. B. M. Mason, United States Navy.

"Measure human sympathy, and you will have taken the dimensions of this subject."*

The subject upon which I have been invited to lecture this evening is one that concerns either directly or indirectly every person in this room. We are all liable at some time to be exposed to the dangers to which I shall refer. My object will be to show you some of the means by which a danger may be met, if by others it has not been prevented. Many of these plans are exceedingly simple, and some of them might be effective if at hand, or in the mind even, in the moment of danger. Few persons are able to invent ideas at that time, but if they have thought over the subject in hours of safety, they may be able not only to save themselves, but all on board.

Perhaps my profession, and the inquiry and correspondence resulting from a paper read by me last year, before the United States Naval Institute, has caused me to overvalue the general interest of the details I have brought together. In enlarging on them before you, I may weary your patience, or in my mode of presenting them I may not do justice to the subject. In asking your indulgence, therefore, I will recall the axiom "Poeta nascitur, orator fit," as specially applicable, in that I have never yet discovered that the role of orator fitted the sailor.

As the description of a number of models and views is necessary

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*Speech of Hon. Chas. B. Roberts, of Maryland, on the Life-saving Service, House Representatives, June 3d, 1878.

to illustrate the subject, the presentation of which will involve some delay, I trust you will excuse me should I trespass a little beyond the usual time devoted to a paper; and that you will understand that, in presenting or favoring any invention, I shall do so with no personal interest beyond that caused by a conviction that they meet admitted wants, and appear, on examination, to justify the approval they have received from others, either making the life-saving service a specialty, or ordered to test them by constituted authority.

I shall divide my subject under the headings of: personal efforts; aids to personal efforts; aids to combined efforts; preservation of ships; and the life-saving services.

PERSONAL EFFORTS.

The first and most important necessities for preservation, in case of marine accidents, are: *coolness* and a *knowledge of swimming.* Coolness, because it allows you to use your mind, to think what it is best to do; if your mind cannot *tell* you, it will at least *advise* you to keep out of other people's way, and do what others, better informed, may suggest.

Swimming, because it enables you to take care of yourself in the water, and perhaps assist others. It is true that a person who could not walk, could still get about by the aid of crutches, mechanical chairs, and the assistance of others; so a person who cannot swim *may* be saved. There are times, however, when, there being no artificial means at hand, only swimming will save you.

Some here may know the old story of "the philosopher and the boatman," who were crossing a river in a boat. The student had been telling his companion that he had wasted *most* of his life by not knowing how to read and write. Soon after, the boat sinking, the boatman asked if he had learned to swim, and on being informed in the negative, remarked that *he* had wasted the *whole* of his.

Swimming should be learned when young; it is a delightful exercise, affording much amusement, as well as a feeling of security to yourself and to your friends when you are near the water. No young person would consider it a hardship to be taught, but few comparatively now have the opportunity.

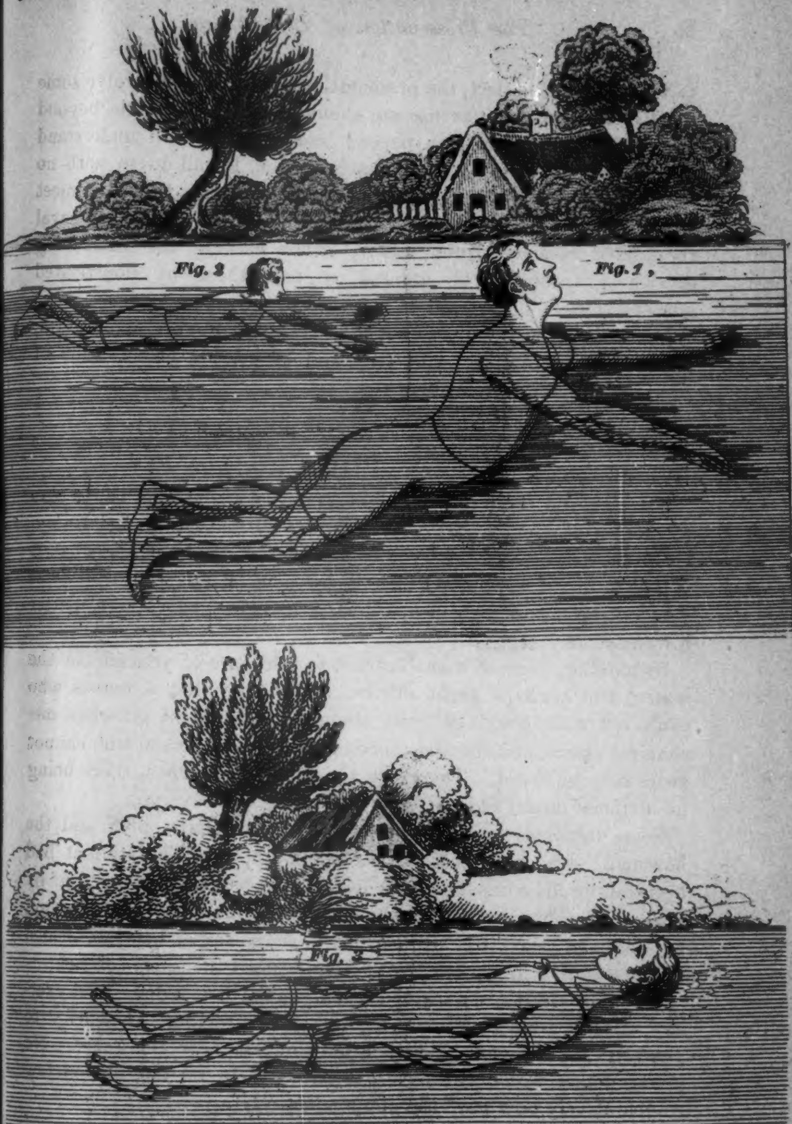

Fig. 1. STIFF POSITION, ATTEMPTING TO KEEP HEAD OUT.
Fig. 2. PROPER POSITION FOR SWIMMING.
Fig. 3. FLOATING ON THE BACK.

The great majority of people cannot swim, and, strange as it may seem to you, there are many who follow the sea as a profession who cannot swim a stroke.

There should be swimming tanks attached to all our gymnasiums and schools, where children should be taught to swim as they are now taught, or ought to be taught, calesthenics, dancing and riding.

I have often heard persons say that the best way to teach a child to swim was to pitch it into deep water, and thus force it to look out for itself. This might teach some, but certainly it would be a most risky method, and one not likely to be tried by a parent. One of the first principles in the instruction is not to frighten the pupil. Confidence once destroyed can rarely be replaced.

Some persons teach swimming by supporting the beginner's head. This is a slow and sometimes unsuccessful way, as is that of using life preservers—neither begetting that all-important quality, self-confidence.

At the United States Naval Academy, where all the cadets are taught to swim, the following method is practiced :

When the new cadets enter, each year, they are asked if they can swim; those who say they can are required to demonstrate the fact; if they show proficiency, they are excused from further attendance in this branch, and are allowed to join the older cadets in deep water bathing. The others are excused as they become expert. Those who cannot swim at all, and they form the large majority, are taken in hand by the swimming master.

They are told that the body, being full of air, will float just as an empty bottle does; that the nose is like the spout of the bottle ; it is all that it is necessary to keep out of the water when open; the mouth being kept closed, as is recommended for all other physical exercises. That when they wish to dive, they must cork up the bottle, or rather, hold their breath. That in swimming, the body must be at perfect ease, and they must not attempt to keep more than the nose out of water.

The extra buoyancy of the body depends on the difference between the weight of the water displaced and the body displacing it. Of course any part of the body which is not displacing water has to be carried as dead weight. The extra buoyancy of an ordinary sized man's body is about eleven pounds. The weight of the head

is from eight to nine pounds. If they try to push the head up out of water they destroy the easy position of the body, and lose the extra buoyancy. A stout person has greater extra buoyancy than a thin one.

Drowning is caused by allowing the water to replace the air in the body; this causes the body to become heavier than an equal volume of water, and therefore to sink.

The point where a body sinks is generally marked by air bubbles. After sinking the first time, the body sometimes rises to the surface again. This has been known to be repeated even a second time.

Men are drowned by raising their arms above water, the unbuoyed weight of which depresses the head. Other animals have neither notion nor ability to act in a similar manner, and therefore swim naturally. When a man falls into deep water, he will rise to the surface, and will continue there if he does not elevate his hands. If he moves his hands under the water in any way he pleases, his head will rise so high as to allow him free liberty to breathe ; and if he will use his legs as in the act of walking (or rather of walking up-stairs), his shoulders will rise above the water, so that he may use the less exertion with his hands, or apply them to other purposes.

The general principles of swimming having been given, the pupil is placed in a tank, about 70 ft. by 15, shelving from about 1 ft. to 10. In order that the tank may be used in winter, it is furnished with a system of steam pipes for heating the water. The pupil is made to lie out in the shallow water, and shown how to strike out. He is then put into a swimming belt; this is a contrivance consisting of a pole, to the end of which is attached a line; at the end of this line is a belt; this belt passes under each arm and across the chest. The pupil lying in the water is told to strike out. The instructor, supporting him with the pole, walks along at the side of the tank; as soon as he sees that the boy is doing well, he gradually slacks down the pole, which the pupil cannot see, as it is behind him, and cannot feel because he is water-borne. When this point is reached, the instructor informs him that he is swimming. If he gets frightened the instructor supports him again; if not, the ice is broken, and no further trouble is experienced.

Once having learned to swim, learn to float, and also to swim on

your back; by this means you can rest yourself, and thus remain in the water a long time. Never remain in from choice, however, after your body begins to feel chilly.

Next learn to swim without using your arms; you have then those members at liberty to assist others.

Never jump in after a person who has fallen into the water unless you are certain that you can be of assistance to him. There are instances of apparently drowning persons rescuing their would-be preservers.

If a person falls overboard and cannot help himself, go to his assistance if you can; if he can help himself, remain where you can assist him out of the water. If you determine to go in, divest yourself of as much of your clothing as possible, especially your shoes. It will be well to mention here that if you are going where you are liable to get into the water, you should have your shoes ready to kick off, or better still, wear low ones.

Having reached the person in danger, if he is not cool and collected, do not approach him so that he can seize you, or he may drag you down with him; either let him exhaust himself, or approach him from the rear, and get him by the hair, or, if he is unprovided with that valuable article, under the chin. Get him on his back, placing yourself in the same position behind him, supporting his head with your hand; strike out for the shore, or wait for other assistance; in this way you can save two or more persons if they are cool subjects. With a very unruly person it is sometimes necessary, for their own good, to use violence; strike them so that they may become insensible. An insensible body, when not filled with water, is very easily handled.

Where a person has gone down, be guided by the bubbles if you cannot see him. Keep your eyes open, and approach him just as directed for surface work.

AIDS TO PERSONAL EFFORTS.

As aids to swimmers, and supports to persons unacquainted with that exercise, thousands of different life-preservers and jackets have been invented.

The best authorities all prefer the cork jacket; rubber and metal

are liable to be worn, corroded or punctured, and, therefore, as they are intended to hold air, become useless. Cork is always the same in all climates, and will stand any amount of rough usage. There are many forms of cork jackets or belts, all more or less good.

For a passenger jacket, the requisites are: as much displacement as possible, with a correspondingly small amount of weight. Suppose that a man has an extra buoyancy of ten pounds, and wears a life preserver of a like weight, which only displaces when submerged ten pounds of water, of course he would get no support from it. If, on the contrary, he had one which weighed only one pound, and displaced, when submerged ten pounds, he would have gained nine pounds of extra buoyancy. They should be fitted with a simple system of webbing straps, not leather, and should tie, not buckle. They should be kept, well in view, in places where they can be reached at any time by passengers. In steamers, where passengers sleep, there should always be one jacket near each bunk, besides those on deck. In conspicuous places, near where they are kept, should be printed notices, with drawings, telling and showing how they are to be used, and advising the passenger to examine them closely, and even to put them on, to tie the straps, to fit them, and become thoroughly familiar with them. The straps should always be securely sewed to the jacket,so that they cannot be pulled off or lost. The jacket should be worn just under the arms, these latter thrust through the armholes or suspenders. They should be tied in front of the body; in this position they serve to keep the nose and mouth out of water. Many bodies have been recovered with the preserver about the waist, and, in some cases, about the legs.

Every boat that leaves a ship, or the shore, on service which is not perfectly safe, should have enough life preservers for its crew and passengers. At sea, these should be kept in the boats; these jackets should always be put on. In practice, however, it has generally been found that men pulling take them off, because they interfere with the arm, forcing it to take a position to which they are unaccustomed in rowing; to obviate this I have designed a jacket, which has been made by Mr. W. H. Godfrey, of this city, furnisher to the Navy and Life-saving Service. This gentleman has also kindly lent me the other jackets which I have shown you. A coat life-preserver made of deer's hair has been lent me by Colonel

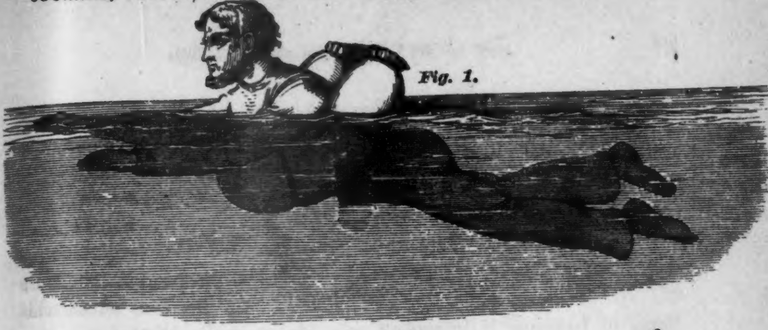

Fig. 1.

Fig. 2,

Fig. 3,

Fig. 4,

Fig. 1. MAN SWIMMING WITH HAMMOCK.
Fig. 2. CORK LIFE PRESERVER.
Fig. 3. PROPER WAY OF WEARING LIFE PRESERVER.
Fig. 4. MAN SWIMMING WITH LIFE PRESERVER.

Bryson. This coat, which may be worn as an over or watch coat, will support with ease three persons.

Although, on general principles, rubber is not a good material for life saving apparatus; still the inflatable sleeves and collar of Capt. Ormsbee are so admirably adapted for life saving purposes that I cannot help mentioning them. These would be particularly useful as the private property of travelers, or for use on our beaches in the bathing season.

Merriman's life dress might also be useful if supplied in small numbers, to be worn by seamen in taking a line ashore.

In the Revised Statutes of the United States we find:

"SEC. 4482. Every steam-vessel carrying passengers shall also be provided with a good life-preserver, made of suitable material, for every cabin passenger for which she shall have accommodation, and also a good life-preserver or float for each deck or other class passenger which the inspector's certificate shall allow her to carry, including the officers and crew; which life-preservers or floats shall be kept in convenient and accessible places on such vessel, in readiness for immediate use in case of accident."

And again:

"SEC. 4484. Every steamer navigating the ocean, or any lake, bay, or sound of the United States, shall be provided with such numbers of life-preservers as will best secure the safety of all persons on board such vessel in case of disaster."

How these laws are actually carried out, can be seen by any person who travels as far as Brooklyn or Jersey City. The life-preservers are on board, but where are they? Strapped up under the cabin ceiling, where no one but a giant could possibly reach them, or stuck under the seats, where none but an expert would notice them. In river steamers they are generally stowed in boxes where no one unacquainted with the fact could ever find them. In ocean steamers they are often kept in some out-of-the way locker. In men-of-war the small number allowed can usually be found in the furthest corner of the yeoman's store-room.

Another, and most effective means of supporting the body in the water, is the adaptation of the bed and other cushions for use as life-preservers. This idea would furnish economical owners with life-preservers, where they had such contrivances, without additional

expense. It would economize space, always a coveted article aboard ship. By their superior size and greater buoyancy, they would support a person in the water better than a jacket.

Every person on board must be provided with a bed of some kind, whether it be the hammock of the sailor or the bunk of the passenger and officer.

For years officers in our own and the English service have been agitating this subject. The great difficulty which all workers in this as well as in all other life-preserving projects have had to encounter, is the unwillingness of those who are in safety on shore to provide for the dangers to which they themselves or others may be exposed at sea. The originator of the idea was probably Rear Admiral Ryder, R. N. In our country, Mr. R. B. Forbes has been indefatigable in urging its adoption, and I would state that Mr. Forbes is and has been one of our most zealous workers. To his energy and perseverance many persons owe their lives to-day. Commander Cyprian Bridge, R. N., found by experiment that the sailors' hammock, carefully lashed, supported seven men in the water for several minutes—four men for almost an hour. Captain Arthur Wilmshurst, R. N., found that a hammock with a six-pound shot suspended from one end—a most trying test—floated for five minutes. The buoyancy of the hammocks was found to be at first 114 lbs. The same shot suspended from the centre was supported nine minutes. The ticking was then oiled, and the hammock supported the weight two and a half hours.

It can readily be imagined that a hammock capable of thus supporting a dead weight would be of great assistance to a man. Had this fact been known to the officers of many of the men-of-war which have sunk suddenly, the loss of life would have been much smaller.

By filling the mattress with cork shavings, which are very cheap, generally being thrown away, additional buoyancy may be obtained. A mattress six feet by four, stuffed with this material, weighed 20 lbs.; its buoyancy was sufficient to support eighty pounds, dead weight, indefinitely. The cost was one-half that of a hair one. A mattress stuffed with granulated cork, 5 ft. 6 in. by 1 ft. 10 in., and 3 in. deep (hammock size), weighing thirteen pounds and having a buoyancy of sixty pounds, is now issued to the men of the Royal Navy.

Mr. Forbes writes that a cotton canvas hammock, containing a mattress stuffed with cork shavings, tested by Lieut.-Cmdr. O'Neil, U. S. N., sustained sixty-two pounds one hour and five minutes, and thirty-two pounds indefinitely. The same hammock, placed in a closely woven water-proofed cotton canvas bag, had its buoyancy increased about four times. Twenty hammocks thus provided, lashed together with a frame-work of spars, would support a 2,000 pound anchor, and one hundred would carry the heaviest anchor used in the navy.

Cocoa fibre has been used as a filling, but I have been unable to obtain any reliable information in regard to it.

Deer's hair, on account of its extreme lightness and great displacement, is also used.

The samples which I have are furnished by Col. Bryson, of the Deer Hair Manufacturing Company. The mattress, which weighs only 5 lbs., is very buoyant. This style of mattress has been used in the Government and Merchant services for several years with excellent results.

A mattress stuffed with felt has just been adopted by the Navy Department and issued for trial. It has also been approved and recommended by a board ordered by the Chief of the Steamboat Inspection Service. This is a step in the right direction, and could steamship companies be made to see that their own interests would be advanced by providing such means, and advertising it, just as hotels have provided fire-escapes and apparatus, a great stride would have been taken.

This mattress is invented and made by Mr. H. D. Ostermoor, of this city. The board of naval officers who tested it at Washington report that "The mattress consists of several sheets or thicknesses of raw cotton, which had been subjected to a great heat, to remove all possible trace of vegetable oils, and then while under pressure to a process which renders the fibres impervious to water or dampness."

A bunk mattress of this kind supported one man weighing 150 pounds, who stood upon it, and a dead weight of fifty pounds of iron, without sinking enough to wet its upper side. It supported two such men, only wetting the soles of their shoes. After twenty-four hours' floating, the ticking having become saturated, the inside was examined and found to be totally untouched by moisture—the ex-

treme outer fibres of the outer sheets being barely touched by the dampness. Heavy weights were then used to sink it, and it remained under water forty-eight hours; upon being examined at the end of this time it was found that the moisture had penetrated between the sheets, the interior of the sheets themselves being entirely free from dampness. The mattress was then dried, when the usual softness and springiness was observed to return to the material. So well pleased were the board with the comfort and cheapness of the mattress, that they recommended it even for shore use. They have, however, already been used for a long time on shore, and even afloat. Alexandre's New York, Havana and Mexican Mail Steamship Line has used them for two years. Pullman uses them in his sleeping-cars, and uses the material for stuffing the cushions of his palace cars, and for the cars of the Metropolitan Elevated Railroad. They are used in many of the Hospitals and Public Institutions. All who have used them testify in highest terms as to their softness, their not lumping, and their cleanliness—there being no animal oil or fat in them.

The objection to mattresses stuffed with cork is their hardness, and sogginess after being in the water for some time. To those with waterproof covers, their smell.

A felt-stuffed pillow weighing three and a half pounds, on which was placed thirty pounds of iron, is reported by the steamboat inspectors to have floated eight days.

A chair cushion would therefore support a man in the water with the greatest ease.

A mattress such as is used in the bunks of vessels fitted, at my proposition, with handles or beckets round the sides, would support several persons in the water. One person may lie on the mattress; the straps being secured over the body prevent a possibility of rolling off. This would be most valuable for children, women, and persons injured during the accident. The handles of one side and one end are provided with snap hooks, so that a number of mattresses may be secured together, to form a raft, which could be improved by the addition of spars and a lashing. The cushions are also to be fitted with handles, the smaller ones being fitted with straps, so that they may be converted into life-jackets. The mattresses intended for

Fig. 1.

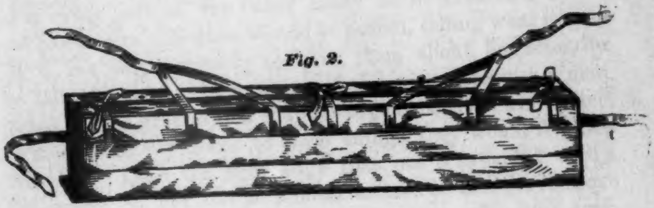

Fig. 2.

Fig. 3.

Fig. 1. FELT BUNK MATTRESS FITTED WITH HANDLES AND HOOKS.

Fig. 2. FELT HAMMOCK MATTRESS FITTED WITH STRAPS AS LIFE PRESERVERS

Fig 3. DEER HAIR MATTRESS, WITH END FITTED AS A LIFE PRESERVER.

hammocks, or as second mattresses in bunks, are fitted with straps and loops, so that they may be doubled over and form life-jackets.

When a lashed hammock is to be used as a life preserver, which would occur when a man-of-war was sinking in the day-time, the clews are to be brought together and secured. This forms a ring-buoy, which is placed around the body, under the arms.

In order that life-saving appliances may be useful in sudden emergencies, they should be numerous, so that in some form they may be at hand in every part of the vessel likely to be inhabited by the crew and passengers. Notices should be posted, telling what may be used; it is not only necessary to have them about, but attention must be called to them. In speaking of this with a steamship man, he objected, on the ground that if too many precautions were taken, and too much publicity given to such things, they would frighten away travelers. Does the knowledge that one is provided with a good fire-escape, to get out of a house in case of fire, prevent one from going there to live? I think, on the contrary, that wise travelers would be attracted by such precautions. The first duty of a traveler embarking, if only to cross the river, should be to look about for them; if he does not see them he should insist upon the employees showing them to him; if he does not succeed he had better go ashore and patronize some other line.

If people would only be as anxious and pertinacious about their safety as they are about their comfort, there would be no need of laws enforcing the carrying of life appliances; companies and owners, in order to secure crews and passengers, would be forced in competition to adopt them.

A person who is going to travel sometimes goes months beforehand to engage a good state-room, and then pays the steward a large fee for a good seat at the table. What does he do towards his preservation? Does he insist upon being shown a certified plan of the vessel, displaying her collision bulkheads, and a list of her fire and life-saving appliances?

Does he insist upon the agent's marking on his ticket what boat he is to go in, or what raft he is to look to for safety, taking care to find out how many others are detailed for the same conveyance, and what its capacity really is?

Does he ask whether the mattresses are buoyant, and whether life preservers are provided at hand, and not stowed away below?

Does he, when he goes aboard, go on deck and find out where the boat or raft is, and how he is to get to it day or night; how he can assist in getting it out, or lowering it; whether it contains oars, life belts, provisions, and water; if not, where they are kept; whether an officer and crew are detailed for it?

Does he go down to his room, examine his mattress, and find out how it works; take down his life-preserver; read the instructions; put it on, and fit the straps to suit his size, making himself familiar with it, so that he can put it on in the dark?

Not a bit of it; 999 look out for their seats at table, see what flowers or delicacies their friends have sent, get their chairs all right, and then lounge about until, mayhap, father Neptune causes them to bow to him. When the hour of danger comes, it is too late to do what might have made them then cool, self-possessed, and self-reliant.

If men would not ship in vessels where they are not provided with proper appliances, owners would be forced to spend a few hundred dollars, and provide them.

If it is impossible to provide these facilities without augmenting the receipts, no sensible traveler, however, would growl at paying a dollar or two more to insure his life.

There are many lines of steamers running between this port and Europe, all more or less poorly provided. Public opinion should force them to do better. There is one line which unites us to a great sister Republic which has been unfortunate, and which, having profited by its experience, is probably the best provided to-day. There is another line which, for a long series of years, by good seamanship and good luck, has never had an accident. Are they as well provided? Many of you, who have traveled intelligently, can probably answer this question.

Another life-saving contrivance is what is called the life buoy, intended to be dropped or thrown to a person in the water by those on board. The larger forms are carried over the stern. They are dropped by some mechanical contrivance. For day work they are sometimes provided with little red flags, so that they may be the more readily seen. At night they are distinguished by a light of

some kind. In our service we use portfire for this light; this has to be lit by a percussion lock and cap, which is fired as the buoy is dropped; this sometimes misses, and the water sometimes extinguishes the light. The French Government has adopted the Silas apparatus. The light in this is caused by the ignition of the gas of phosphurated calcium. Phosphurated calcium, which is common chalk, acted upon when at great heat by the fumes of heated phosphorus. The product, which is brown in color, and in lumps of the shape into which the chalk was broken, when thrown into water, or acted upon by great dampness, gives off a gas which ignites with a brilliant flame on combining with the air. On account of this peculiar quality, it must be kept in an air-tight case, which has been previously thoroughly dried; in this state it is harmless. For use, the receiver, which is of glass generally, is placed in a tube placed vertically through the centre of the float; this tube is open at either end. As the buoy drops a plunger is released, which opens the receiver; the water, coming up through one end of the tube, acts upon the calcium, liberating the gas, which, passing up through the tube, and escaping through the upper ends, unites with the air and becomes inflamed. Of course, water will not extinguish this light. A person dropping a buoy to one who has fallen overboard from forward, should wait until he is as near to him as possible. When the person is already astern, let the buoy go as quickly as possible. If the buoy is too far from the person, it may never be reached by him. The wind or current also act sometimes to carry it away from him. Mr. Forbes reports very excellent results in preventing this by attaching to each buoy a little canvas cone, which acts as a drag or sea anchor. About the decks there should be a number of ring buoys, which a cool person may pitch almost into the hands of a person overboard. When these are not at hand, gratings, chairs, or any floatable object should be used.

The ring buoy is another form, and should always be carried in considerable numbers about the decks. The two which I have here this evening are rather large ones. One is of granulated cork, very heavy, and liable to become water-soaked; the other of deer's hair, very light and buoyant.

Few small life-saving contrivances are intended to support the

whole dead weight of the body; they are intended to be held on to. Never attempt to climb on top of a life-buoy, for instance; it will support you as long as you keep your body submerged.

The following directions for restoring the apparently drowned are from the latest instructions issued by our Life Saving Service; they are those of Dr. Howard.

Where you can do so, send immediately for a regular medical practitioner.

Rule I.—*Arouse the Patient.*—Unless in danger of freezing, do not move the patient, but instantly expose the face to a current of fresh air, wipe dry the mouth and nostrils, rip the clothing, so as to expose the chest and waist, and give two or three quick smarting slaps on the stomach and chest with the open hand. If the patient does not revive, proceed thus:

Rule II.—*To Draw off Water, &c., from the Stomach and Chest.*—If the jaws are clenched, separate them, and keep the mouth open by placing between the teeth a cork, or small bit of wood; turn the patient on the face, a large bundle of tightly rolled clothing being placed beneath the stomach, and press heavily over it for half a minute, or so long as fluids flow freely from the mouth.

Rule III.—*To Produce Breathing.*—Clear the mouth and throat of mucus by introducing into the throat the corner of a handkerchief wrapped closely around the forefinger; turn the patient on the back, the roll of clothing being so placed as to raise the pit of the stomach above the level of any other portion of the body. If there be another person present, let him, with a piece of dry cloth, hold the tip of the tongue out of one corner of the mouth (this prevents the tongue from pulling back and obstructing the windpipe), and with the other hand grasp both wrists, and keep the arms forcibly stretched back above the head, thereby increasing the prominence of the ribs, which tends to enlarge the chest. The two last-named positions are not, however, essential to success. Kneel beside or astride the patient's hips, and with the balls of the thumbs resting on either side of the pit of the stomach, let the fingers fall into the grooves between the short ribs, so as to afford the best grasp of the waist. Now, using your knees as a pivot, throw all your weight forward on your hands, and at the same time squeeze the waist between them, as if you wished to force everything in the chest

Fig. 1.

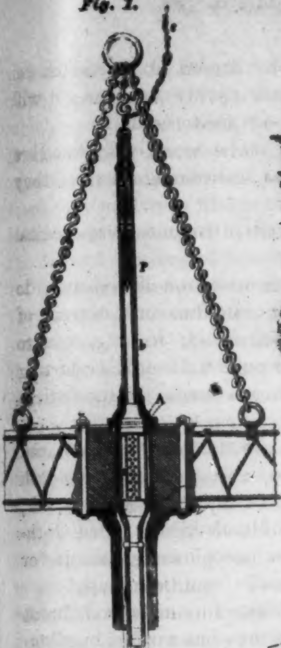

Fig. 3.

Fig. 4.

Fig. 2.

Fig. 1. SILAS LIFE BUOY.

Fig. 2. RING BUOY.

Fig. 3. SHOWING EJECTION OF WATER FROM BODY.

Fig. 4. SHOWING METHOD OF RESTORING RESPIRATION.

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upward out of the mouth; deepen the pressure while you can count slowly one, two, three; then suddenly let go with a final push, which springs you back on your first kneeling position. Remain erect on your knees while you can count one, two, three; then repeat the same motions as before, at a rate gradually increased from four or five to fifteen times in a minute, and continue thus this bellows movement, with the same regularity that is observable in the natural motions of breathing which you are imitating. If natural breathing be not restored after a trial of the bellows movement for three or four minutes, then, without interrupting the artificial respiration, turn the patient a second time on the stomach, as directed in Rule II, rolling the body in the opposite direction from that in which it was first turned, for the purpose of freeing the air passages from any remaining water. Continue the artificial respiration from one to four hours, or until the patient breathes; and for a while after the appearance of returning life, carefully aid the first short gasps until deepened into full breaths. Continue the drying and rubbing, which should have been unceasingly practised from the beginning, taking care not to interfere with the means employed to produce breathing. Thus, the limbs of the patient should be rubbed, always in an upward direction towards the body, with firm grasping pressure and energy, using the bare hands, dry flannels or handkerchiefs, and continuing the friction under the blankets, or over the dry clothing. The warmth of the body can also be promoted by the application of hot flannels to the stomach and armpits, bottles or bladders of hot water, heated bricks, stones, &c., to the limbs and soles of the feet.

Rule IV.—*After-Treatment.—Externally:* As soon as breathing is established, let the patient be stripped of all wet clothing, wrapped in blankets only, put to bed comfortably warm, but with a free circulation of fresh air, and left to perfect rest. *Internally:* Give a little brandy and hot water, or other stimulant at hand, every ten or fifteen minutes during the first hour, and as often thereafter as may seem expedient. *Later manifestations:* After reaction is fully established there is great danger of congestion of the lungs, and if perfect rest is not maintained for at least forty-eight hours, it sometimes occurs that the patient is seized with great difficulty of breathing, and death is liable to follow unless imme-

diate relief is afforded. In such cases apply a large mustard plaster over the breast. If the patient gasps for breath before the mustard takes effect, assist the breathing by carefully repeating the artificial respiration.

An eminent authority, Dr. Labordette, the Supervising Surgeon of the Hospital of Lisieux, in France, appears to have established the fact that the clenching of the jaws and semi-contraction of the fingers, which have hitherto been considered signs of death, are, in fact, evidences of remaining vitality. After numerous experiments with apparently drowned persons, and also with animals, he concludes that these are only signs accompanying the first stage of suffocation by drowning, the jaws and hands becoming relaxed when death ensues (the "rigor mortis" occurs later after the temporary relaxation here referred to). This being so, the mere clenching of the jaws and semi-contraction of the hands must not be considered as reasons for the discontinuance of efforts to save life, but should serve as a stimulant to vigorous and prolonged efforts to quicken vitality. Persons engaged in the task of resuscitation are, therefore, earnestly desired to take hope and encouragement for the life of the sufferer from the signs above referred to, and to continue their endeavors accordingly. In a number of cases Dr. Labordette restored to life persons whose jaws were so firmly clenched that, to aid respiration, their teeth had to be forced apart with iron instruments.

Directions for restoring the apparently drowned should be legibly printed, with accompanying plates, and posted in every steamer, ferry-house, and public building near the water, on wharves and bridges—in fact, everywhere—that they might be made useful either to the idler, or the person desiring to refer to them. In England the Royal Humane Society has adopted this device; why cannot our own Life Saving Benevolent Society do the same?

AIDS TO COMBINED EFFORTS.

Under this head we will class all the life-preservers coming between the personal float and the ship, whether used from the shore or from vessels. Ordinary pulling boats are generally, except in fine weather, of little use in saving life. They are too often,

especially in the navy, built for speed instead of safety. A boat, to be of use in bad weather, or in approaching a rock, or surf bound shore, should be fitted so as to be easily gotten out, or lowered, very buoyant, unupsetable, unsinkable, and easy to be handled and beached.

For ordinary boats, of which by-the-bye it would be almost impossible to carry enough to safely transport all the passengers and crew of large vessels, in selecting a lowering apparatus, we have to be governed to a certain extent by other necessary qualities. A sea-going vessel cannot carry her boats rigged out, as they would certainly be carried away in anything like a bad sea. In a vessel rolling very badly, if they were not carried away, by filling with water they might prevent the vessel from righting. Some ships cannot even carry their boats on the rail, but have to take them inboard. In coming alongside of other vessels, or docks, it is necessary that the boats should be rigged in. In most vessels this is done by first hoisting the boat by means of davits, or derricks. If the boat is to come inboard, or on the rail, these are turned, and the boat lowered into chocks, or into a cradle. So far the operation is of no importance, as there is no hurry, and plenty of men and mechanical contrivances are at hand. When, however, the boat has to be gotten out, its whole weight has generally to be raised out of the chocks, or cradle, under the most disadvantageous circumstances. It has then to be turned outboard, quite a complicated manœuvre, and lowered with great care and at great risk of being dashed to pieces against the side, or capsized before the tackles are unhooked. In order to obviate all these difficulties, it is necessary to have a boat lowering apparatus, and then a boat detaching one.

There are many different forms of both of these, but I am sorry to say that even the best are more often found in books and models than in actual practice. They are expensive, or at least more so than nothing—this is enough to condemn them.

Mr. Forbes has sent me a contrivance which he recommends most highly, and which, I should judge, must be very excellent, and as cheap as an ordinary davit. There are two upright stanchions built into the rail; hinged to these, at the height of the deck, are two pieces which act as the arms of derricks. The upper ends are connected by a fore and aft piece; on this fore and aft piece, which also

acts as a strong back for the boat, are the tackles. To prevent this arm from going out too far when out, or coming in too far when in, there is a length of chain permanently attached to the head of the stanchion. To prevent the arm from coming in when out, and going out when in, there is a rigid hook bar. A chain pennant, to the end of which a tackle is fitted, is used to bring the arm to a vertical position, and lower it either in or out. The important feature is, that when in the boat can be rigged out by being pushed upon, no raising being necessary. The tackles, when the boat is hoisted, are replaced by single ropes, so that the boat can be easily lowered. The boat-detaching apparatus of Ensign Bradley A. Fiske, U. S. N., adopted for use in the navy, works very well. The object of a detacher is, to let go both ends of the boat at once as she approaches the water; this must be done by one person, placed at some central point. It may even be necessary, when the ship is rolling heavily, to let go half way down, to prevent being smashed against the side. A ship's boats should be, if possible, of the life-boat type; if they are not, they should at least be fitted with air tanks under the thwarts, or cork paddings round the rail outside. The rudders should always be kept shipped. An oar is preferable to a rudder, if properly shipped, when quick work is to be done. There are many different types of life-boat, from the large steam ones used by the English and French to the small, very small, zinc ones used aboard our river craft. All are more or less good. They are made as light as possible, are given great displacement, and consequently buoyancy. They are made self-bailing, by being provided with valves in their bottoms, or even by having the bottoms almost entirely open to the sea. Boats for pulling, quick handling, and beaching, should be fitted with centre-boards, and without keels.

As we have stated, it is almost impossible for a large vessel to carry enough boats for all the people she may have on board. Other contrivances must be at hand in the way of rafts. The Rider life raft is the one which seems best to meet the requirements of the case. These have been adopted in our service. The model is furnished by the present makers to the navy, the "Gondola Life-boat and Raft Company." The advantage of this contrivance is, that it affords a very large amount of buoyancy when submerged. It is very light, and when not inflated takes up but little room, a coveted

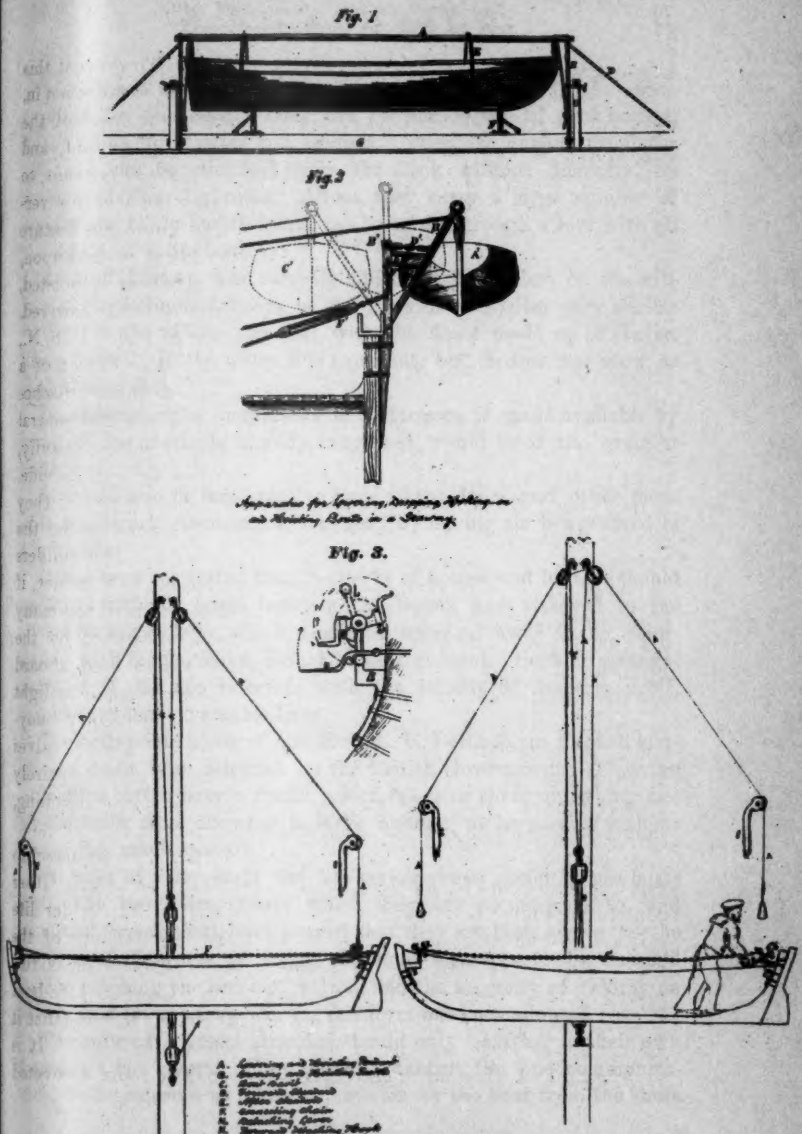

Fig. 1. SIDE VIEW OF FORBES' DAVITS.
Fig. 2. END VIEW OF FÓRBES' DAVITS.
Fig. 3. FISKE'S DETACHING APPARATUS.

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article aboard ship. Many of these can be carried in the space required for one boat. They can be put on top of deck-houses, lashed under forecastles and bridges. They are quickly fitted for use, and can be launched from the deck without difficulty, on account of their lightness. Afloat, they carry a large number of people, are easily handled, and can be taken through a surf with all the safety of a life-boat.

Admiral Ammen, who recently addressed this society on the subject of the Isthmus Surveys, is the inventor of a bolsa very similar in form to the rubber one, but with the floats made up of staves, like a barrel. In the water it is excellent, but it does not stow as well aboard ship.

In making rafts, hammocks or mattresses, if made available by some of the methods already suggested, would be of the greatest utility.

It would also be important to have all the doors and other movable woodwork given extra buoyancy by having air boxes fitted in the panels.

It has been suggested that the decks of houses and bridges should be fitted with air boxes between the beams, and attached to the vessel by heavy keys, which could be knocked away in an emergency with mauls, which should be kept at hand. Such an arrangement, if it did not interfere with the solidity of the ship itself, might save many valuable lives.

The collapsible boats of the Rev. E. L. Berthon, an English clergyman, have been adopted by the British Government. They are of canvas fitted over a frame, which opens or shuts something like an umbrella, thus allowing a large number to be carried without occupying much space.

On most of our coasts the life-saving crews prefer to use boats built like the fishing boats which they are accustomed to, and as actual experiments have proved that they are best, owing to the peculiar shallowness of water, the long distances to be traveled before reaching the scene of action, and the necessity of taking on nearly raw crews every winter, this form has been adopted.

The crew of a vessel stranded should only leave her in their own boats as a last resort. They should establish the line communication, to be referred to hereafter, or wait for the boat from the shore

Few sailors are good surfmen ; in fact, it is a profession by itself. Not being surfmen, they cannot prevent their boats being upset or pitch-poled (thrown end over end) when they get in the surf. If they do have to use their boats, they must anchor outside of the surf and get up a line communication from there. If it is absolutely necessary to go through the surf, a flexible raft made of hammocks or mattresses, which will bend to the action of the wave and not pitch-pole or capsize, will be found much safer than a boat. We will not attempt here to give the proper method of handling a boat in the surf.

SHIPS.

The dangers to which ships are usually subjected are: burning colliding, upsetting and stranding. Much can be done to protect the ship against all of these dangers, and it should be the traveler's duty to assure himself, before engaging passage, that all these precautions have been taken. This could easily be shown by a sworn statement and plans, with a heavy penalty attached to deception. At present the competition is so great between companies that they have to do everything as cheaply as possible. There is not to-day one single vessel sailing or steaming from this port or any other which is properly provided. If a law were passed, either by constituted authority or the good sense of the traveling public, they would all start fair in the race for safety. We see references made to water-tight compartments and collision bulkheads. They do not exist, in practice, any more than we can call the walls of this room water-tight. Some of the vessels are provided with partitions, which might be made water-tight, but not at the moment when they are needed. To be of use, they must be so beforehand. There must not be a single opening in them below the water-line, and even for some distance above it, as the line of floatation would be raised, by the filling of one of the compartments, to a considerable extent. A very small hole, such as a sluice-valve, takes from a partition any claim to be called water-tight. Any one who has studied hydrostatics knows what a quantity of water can pass through a small orifice in a short space of time. Compartments must be absolutely water-tight. They must be several stories high,

Fig. 1.

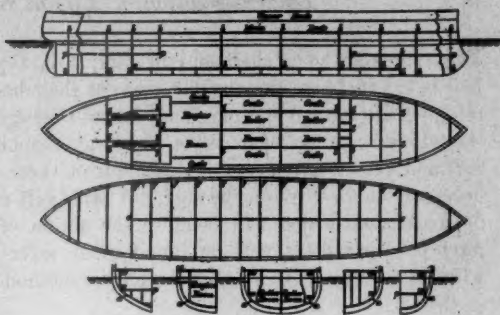
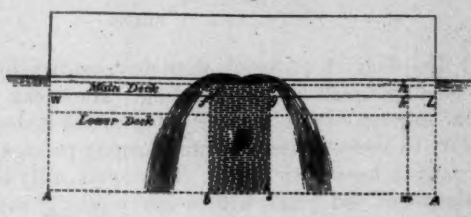


Fig. 2.



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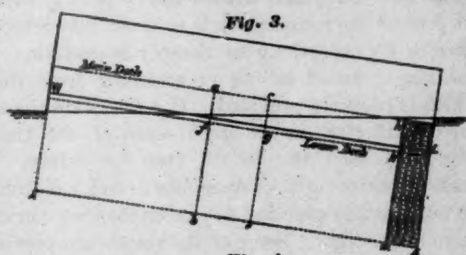

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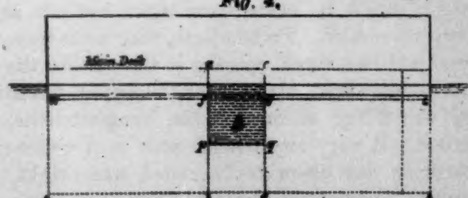


Fig. 1. THE LATEST ARRANGEMENT OF WATER TIGHT BULK HEADS.
Fig. 2. EFFECT OF BULK HEADS NOT BEING HIGH ENOUGH, WHEN WATER LINE IS RAISED BY A COMPARTMENT FILLING.
Fig. 3. NECESSITY OF SMALL COMPARTMENTS AT EXTREMITIES.
Fig. 4. BENEFIT OF HORIZONTAL PARTITIONS.

and the decks or floors of these stories must be absolutely water and air-tight. The bottoms must be double. The whole under water, and up to at least six feet above the water, part of a ship, must be like a honeycomb. The bulkheads must run fore and aft as well as athwart ship. The engine and boiler-rooms must be in compartments as well as the rest of the ship. This can easily be done if it must be done. The shafts can be made to work through water-tight bearings through the partitions, just as they do in the stern-post. The very part of the ship occupied now by an immense open space, is the one which we should most subdivide. The forward compartments should be very small, so as not to lift the screw and rudder out of the water when they filled. The coal should be stowed well up on both sides of the engines and boilers to protect them, and also to be at hand, so that no excuse could be made of difficulty of getting at it on account of the bulkheads. Each compartment should have a separate pump, and each of these pumps should be fitted to work for water or air. None of the engines for working these pumps should be placed down in the engine-room where a fire might cut them off. Each compartment should be fitted with an electric fire alarm, and if possible with an automatic extinguisher. Cargo should all be packed in waterproof cases, or, better still, in barrels. The compartments being full of such packages would admit but little water. What did come in could be forced out by turning on the air-pump. The steering gear of all ships should be worked by steam and hand, and the helmsman placed forward close to the officer of the deck, who should be there also. A second apparatus should be placed aft in case of accident. The officer of the watch should be able to stop the engines himself without leaving the bridge. This can be done by electricity, and has been worked successfully aboard a French man-of-war. There should be an ample supply of fire extinguishers, buckets and axes always at hand. There should be permanent steam or water pipes such as are fitted in hotels and large buildings, by which steam or water could be sent to every part of the ship by syphon or other pumps. Each apartment should be provided with a tap to this pipe, and a piece of hose long enough to reach any part of it.

In case of meeting a vessel at sea, in the daytime, there is generally but little danger of collision, but collisions have occurred;

therefore we must guard against them. The great cause of collision is a want of knowledge of what the other ship is doing or going to do. In other words, how she has her helm. This could easily be remedied by having a semaphore at the mainmast head, similar to those used on railroads; this to be connected automatically with the steering wheel. As port is always designated by red (let us suppose because port wine is of a reddish color) and starboard by green, when the helm was put to port, the red arm would rise in proportion to the angle of the rudder; when the helm was amidships neither arm would be up; when the helm was put to starboard the green arm would rise. In this way, on any side, the position of the helm could be seen.

At night lights might be attached to these arms, or the officer of the watch might carry in his starboard and port pockets a green and a red signal, which he could burn in the same way. It was ordered at one time by the English Board of Trade that this light system should be adopted in the following manner: That a light of the color of the side to which the helm was put should be shown on deck on approaching, or a little ways up the rigging of a vessel. A vessel always carries, or should always carry, at night (some owners and captains are so mean that they attempt even to evade this law, by not carrying their lights when they are clear of the harbor authorities—men-of-war should be empowered to capture every vessel found without lights), on the starboard side, well forward, a green light, so protected that it cannot be seen abaft the beam; on the port side, a red light. A steamer carries at her foremast head a white light. In practice, when the helm signal was exhibited, confusion arose, because all the colored lights were so nearly on a line. This caused the order to be rescinded. I propose that the lights carried by the officer of the watch shall be of the system which is now coming into operation for general signals—that is, that the light shall be projected into the air by being fired out of a pistol or case. This would prevent all confusion, and it could then be seen on all sides. The signal lights which I have here are made by Mr. Edward S. Linton, and would be just the things to carry out the idea. They are cylinders stopped at one end, and containing any number of stars that may be desired. These stars are projected one after the other, at equal intervals, to a great height in the air, where

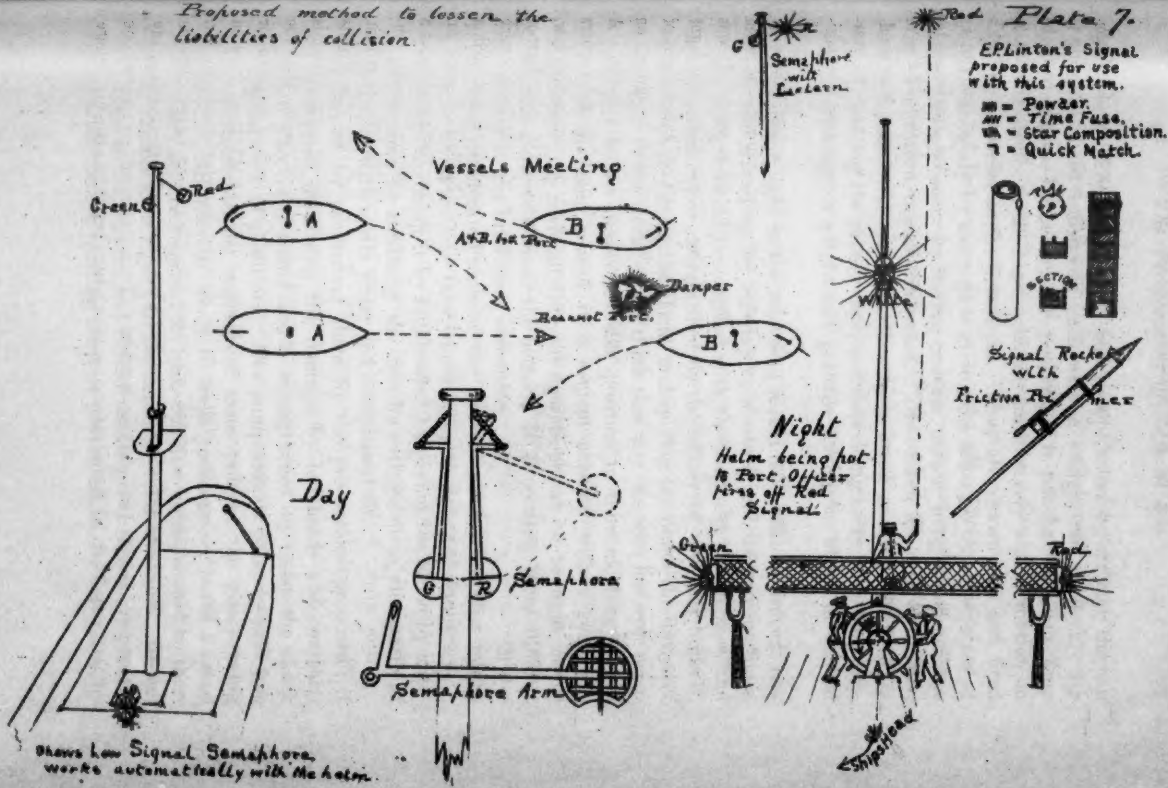
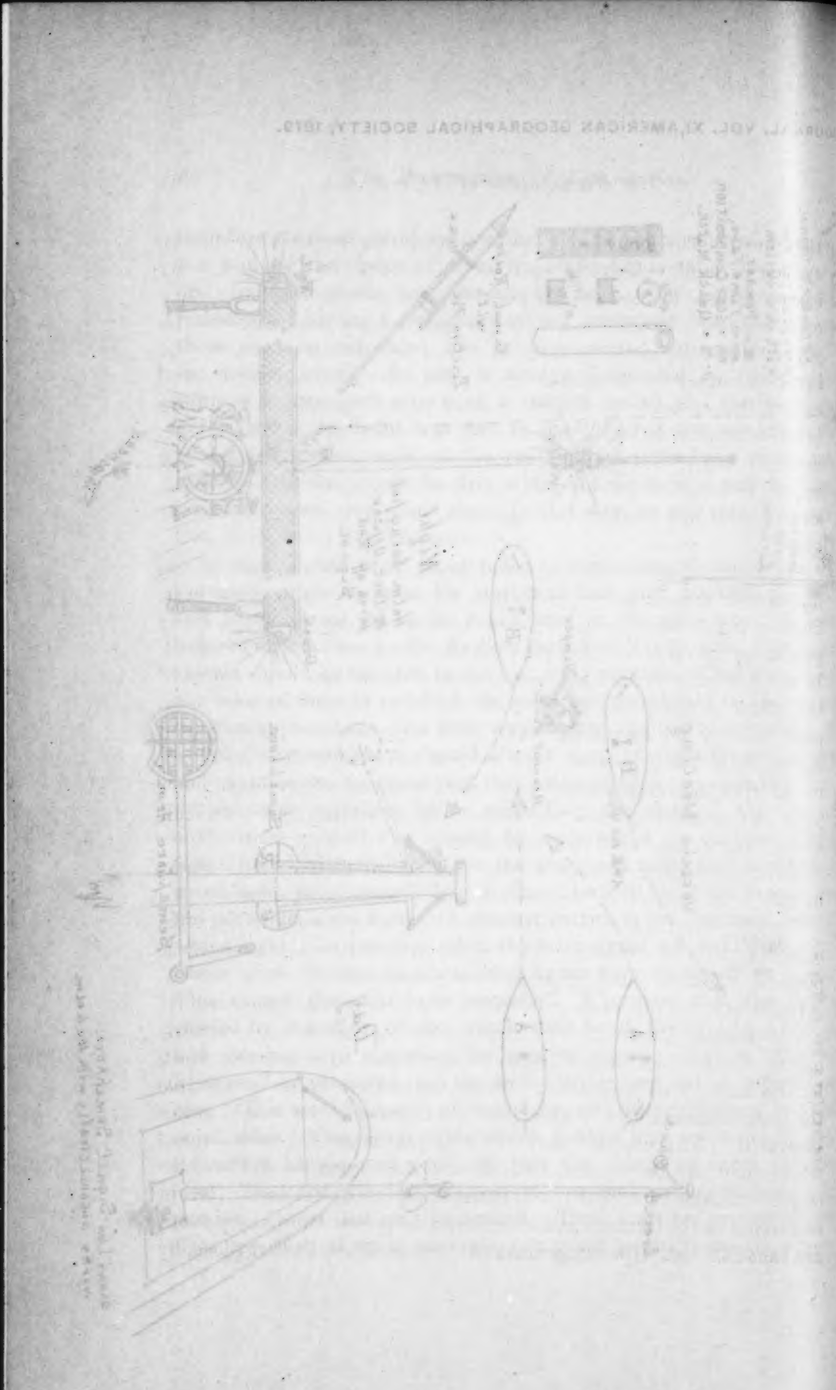


Plate 7.
Proposed method to lessen the liabilities of collision
E.P.Linton's Signal proposed for use with this system.
= Powder.
= Time Fuse.
= Star Composition.
= Quick Match.
Section
Signal Rocket with Friction Primer
Semaphore with Lantern
G
R
Red
White
Vessels Meeting
Green
Red
A
B
A+B, hel Port
Danger
A
B
Day
Night
Helm being put to Port, Officer fires off Red Signal.
Green
Red
Semaphore
G
R
Semaphore Arm
Ships Head
Shows how Signal Semaphore works automatically with the helm



they burn. The machine is put in operation by striking the cap against a hard substance, such as the bridge, rail, or deck. By carrying these in the two side pockets, or in pouches on a belt, they come naturally to the hand, which is instinctively put in motion on giving the order to the helmsman. They are drawn out and fired instantaneously by the person giving the order, so that the factor of error liable to occur by having another person bungle, and perhaps break a lantern, is also eliminated. The rocket which I have here, made for me by the same gentleman, is fitted so as to be fired by merely pulling the primer tape, and thus doing away with the necessity of looking for a light and perhaps having it blown or washed out.

An electric light at the masthead would do much to prevent collisions and stranding, by lighting up a vessel and its surroundings. Such a light could be supplied with electricity by the engines, and put in operation or extinguished by the officer of the deck himself. It will probably seem that I am multiplying too much the duties of the officer of the deck; but I think that any one who has ever occupied that by no means enviable position in time of danger, will agree that, being placed in a central position with a good all-round view, the more all different operations can be brought under your own personal control the better. It is getting more difficult every year to get intelligent assistants.

Having enumerated some of the general precautions that might be taken, let us see how they would apply to our cited dangers.

Fire, by localizing it by bulkheads; by giving the alarm by automatic means; by subduing the fire by extinguishers, automatic or portable, or with steam water and compressed air.

Collisions, by preventing them by the precautions proposed; if not prevented, localizing the damage by bulkheads and compartments. The vessel would also be strengthened to resist the shock by the network of partitions. The pump and air pumps would free the compartments, the waterproof cases prevent the goods being saturated. All persons likely to hold positions on board a vessel where they will be required to look out for lights, should be thoroughly examined in regard to Daltonism or color blindness. Recent researches in the German and French navies prove that many persons are thus affected. Upsetting must be prevented, in the first place, by

the naval architect when he plans his vessel; by the stevedore when he loads her, and by the seaman when he handles her. Although within the province of this paper, our limited time and your already overtaxed patience will not permit me to go more fully into this subject than to call your attention, if you are professional men, to the excellent new method of Mr. Forbes for reducing top hamper, and to the fact that when the rolling period of the ship and the period of the sea approach very closely, it is better to heave to or change your course.

Stranding must be prevented by navigation, by continual sounding and reference to the chart when approaching the shore. As under the previous head, I must omit the interesting technical facts connected with improved compasses and sounding apparatus, especially those Captain Belknap and Lieut.-Commanders Sigsbee and Jewell. Improved methods of approaching dangerous places, such as the method proposed by Lieutenant Truedell, of the French Navy, now employed as a captain in the service of the Transatlantic Company, for entering the harbor of New York in foul weather. There is one point, however, referring to this head and that of collision, which I would like to call your attention to; it is the fact that fogs are not generally very high above the water; that a vessel's masts sometimes project into a clear atmosphere above—that if a man is sent aloft, where, by the bye, one ought always to be, at least during the daytime, to look out for wrecks and rafts, or boats, he can often see the masts of approaching vessels, land, and other high objects. This is not generally thought of, even by seagoing people. A story is told of a captain, who was cruising off Wilmington, in the South, a few years ago, for the benefit of his health. At night, the vessels all hugged in close to the bar, to pick up excursion parties, who might be carrying out too much cotton. One morning (it was foggy) this officer decided, as he was very close in, to wait later than usual. Suddenly he heard the pleasant whistle of a shell, right between his masts; followed by another, with a slight improvement of aim. He politely requested one of his men to go aloft, and see what was the matter. This individual suddenly emerged into the clear sunlight, and took an instantaneous view of the Mound Battery, which was also enjoying a beautiful morning. It is needless to say that the vessel changed her range, and that the captain had learned a lesson.

THE LIFE-SAVING SERVICES.

The next subject is the consideration of what is being done on shore for the safety of the traveler.

The Light-house Service affords great protection. This service, although under the Treasury Department, is actually administered by the officers of the Navy and Army Engineer Corps. Admiral John Rodgers is at present the chairman of the board, which is made up of: three naval officers, two army officers, one ex-naval officer, and one scientist. The coast, rivers and lakes are divided into fifteen districts, each of which has a naval officer for its inspector, and an army engineer for its constructor. Other officers are detailed as assistants in the large districts. There are on the Atlantic coast 451 lights, 43 hot-air or steam fog-signals, 422 day beacons, and 2,610 buoys. On the Pacific coast there are, in all, 211 aids to navigation. We omit those on the rivers and lakes. There are 33 light-ships on outlying shoals and dangers.

If all these lights were of good quality, our coast would be fairly well lighted. There is one improvement that should be made, and would be, probably, if the funds were appropriated. Every light-house, and especially outlying light-ships, should be signal and telegraph stations. They would then be able to give warning of bad weather, and if a wreck occurred near them, or was likely to occur, they could signal for aid to the nearest port or life-saving station. Many valuable lives and cargoes are lost, when the timely arrival of a tug or ground tackle would have saved all.

The navy, with a large corps of officers and ships in every port of the globe, is continually collecting information which renders navigation more safe, and therefore preserves life. There are some ships on special duty surveying the coasts of countries which are either uninhabited, or too poor to do the work themselves.

The army, with its signal service and "Old Probabilities," warns the mariner of approaching bad weather, and allows him time to prepare for the fight.

The private enterprise of one of our journals has done much to save life in giving notice of the approaches of distant storms, and advocating the adoption of greater precautions in the building of ships.

The Coast Survey, with its efficient head, an ex-naval officer, and a large number of assistants, most of whom are naval officers, is constantly watching our coast, giving notice of shifting channels, and newly-discovered dangers, locating old ones which have been reported, and furnishing charts, which are guides to all the world approaching our shores.

In England, much is done to save life. Two great benevolent societies are at the head of the movement: the Royal Humane Society, instituted in 1774, to collect and circulate the most approved and effectual methods for recovering persons apparently drowned or dead; to suggest and provide suitable apparatus for, and bestow rewards on, those who assist in the preservation and restoration of life. The Queen is its patron; the Duke of Argyle its president. Connected with this society are many local ones or branches.

The Royal National Life-Boat Institution, incorporated in 1824, under the name of the "Royal National Institution for the Preservation of Life from Shipwreck," and changed to its present title by a new charter in 1854. The Duke of Northumberland is the president. This society, aided by sub-societies and donations, provides the life-boats and apparatus for the whole English coast. The boats are generally very large ones, some of them being propelled by steam. The English coast is, at most points, very high. It is indented with many small harbors. The boats are kept in these harbors. The population of the coast is much more numerous than ours especially the maritime portion of it. The crews—they have very large ones—are all made up of volunteers, who are paid while in service. If successful in saving life, they receive special pecuniary rewards. The boats and crews are managed by what are called "local committees," the coast-guard naval officer being by the constitution a member. Where the distance to be traveled is great, steam and sail are used. For line-throwing, the Boxer rocket is used. This is a large rocket, very similar to that used for war purposes; it is fired from a wooden trough, which gives its direction and the proper elevation; the line is attached to the rocket. The method of using the line, being identical with ours, will be explained in connection with our own service. In 1874, there were 240 boats belonging to this society. The donations to the society in 1873 amounted to £31,740. In that year it saved 668 lives, and alto-

Fig. 1.

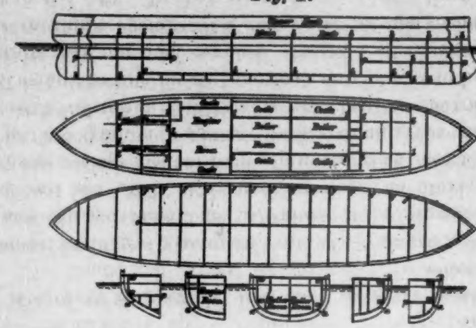
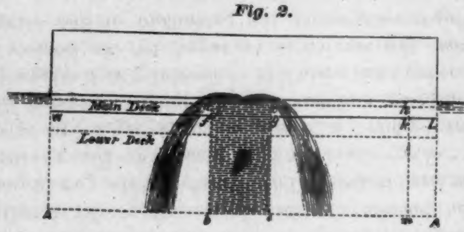


Fig. 2.



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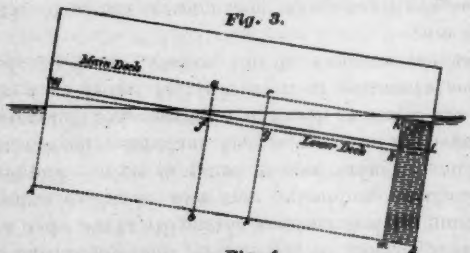


Fig. 4.

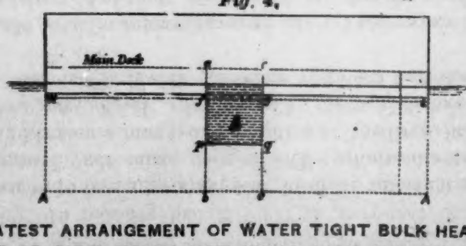


Fig. 1. THE LATEST ARRANGEMENT OF WATER TIGHT BULK HEADS,

Fig. 2. EFFECT OF BULK HEADS NOT BEING HIGH ENOUGH, WHEN WATER LINE IS RAISED BY A COMPARTMENT FILLING.

Fig. 3. NECESSITY OF SMALL COMPARTMENTS AT EXTREMITIES.

Fig. 4. BENEFIT OF HORIZONTAL PARTITIONS.

gether, up to that year, 22,153. It had granted 940 gold medals. These figures are for 1873–74, five years ago, and of course have increased very materially. The English claim that Lieutenant Bell, of the Royal Artillery, was the first to invent a means of conveying a line to a vessel, in 1791. Capt. Manby, R. N., was, however, the most successful of the early workers. His shot was used as late as 1862.

The British Society for the Encouragement of Arts, Manufactures and Commerce offered, in April, 1878, their gold medal to the person submitting the best means of saving life at sea when a vessel has to be abandoned suddenly, say with only five minutes' warning, the shore or other vessels being in sight. The decision has just been rendered in favor of cork mattresses faced with hair. I think that our cotton or deer hair mattresses are still more effective. It would be interesting to have this fact tested by a competitive trial, under the auspices of this society, or of the Life-Saving Benevolent one.

In France, the organization is somewhat similar to that of England, "The Société Centrale de Sauvetage des Naufragés" controlling the local boards. The French use the gun in preference to the rocket. They claim for M. Ducarne de Blangy the credit for having first invented a means of conveying a line by means of a projectile in 1790, and to a naval paymaster, named Broquet, the credit of having used a life kite successfully at Boulogne, in 1851.

In Russia, the service is managed by the Society for Assistance at Shipwrecks, under the patronage of the Grand Duchess Cæsarevna.

In Germany, Austria, Italy and Turkey, it is in the hands of similar societies.

In our own country, the first regularly organized society which undertook the duty of preserving and restoring life was the Massachusetts Humane Society; formed in 1786, and incorporated in 1791. It began the erection of huts, for the shelter and comfort of persons escaped from wrecked vessels upon exposed and desolate portions of the coast of Massachusetts, in 1789; the first one being erected on Lovell's Island, near Boston. It maintains at the present day eight such huts. Its first life-boat station was erected at Cohasset, 1807. Up to 1870, the Government appropriated in all

$35,000 to assist it. It had in 1876, with the assistance of the Government, 76 stations in hand.

The second society was, The Life-Saving Benevolent Society of New York, incorporated in 1849. Since that time it has rendered the greatest assistance in organizing the life-saving stations on the coasts of New York and New Jersey. It has awarded a large number of medals, and has encouraged the saving of life by volunteers. Its first president was Walter R. Jones, Esq.; its present one is Mr. John D. Jones. Its Vice-President, Mr. Royal Phelps. Mr. W. H. H. Moore, a member of our council, is one of its most zealous workers.

The Hon. William A. Newell, of New Jersey, a member of Congress in 1848, by a very strong speech, succeeded in getting an appropriation of $10,000 for surf boats and other appliances, to be used on the Jersey coast—from Sandy Hook to Little Egg Harbor. This amount was expended under the direction of officers detailed from the Revenue Marine Service and the New York Life Saving Benevolent Society.

Captain Ottinger, the inventor of the life-car, is represented in an old plate as experimenting with his life-saving gun and life-car, before a committee of the society—Messrs. Walter R. Jones and Lambert Suydam.

Eight stations were the result of this appropriation. Captains McGowan and Faunce also began their long and honorable connection with the service at this time.

March 3d, 1849, the Government made further appropriations for the erection of stations on the Long Island and Jersey coasts, so that at the end of the year about twenty-two stations were in operation. These stations were all manned by volunteer crews, and did excellent service.

Small appropriations were continued, and some few additional stations built; but the service did not really take any definite shape until the winter of 1870–71, when Congress made an appropriation of $200,000, and the present life-saving service was organized in 1872, under the Treasury Department. The work done by it seems almost incomprehensible, in view of the smallness of the appropriations. Even these appropriations are due to the untiring personal efforts of the Hon. Charles B. Roberts, of Maryland, and our

townsman the Hon. S. S. Cox. To Hon. Sumner J. Kimball, a New Yorker, its Superintendent; Captains McGowan and Merriman, and Lieutenant Walker of the Revenue Marine, his senior assistants, the greatest credit is due. We know little of the difficulties which they have had to surmount. Results are the best means of measuring the value of an institution. Wherever the proper development has been afforded by legislative action, the success has been wonderful. The coast of North Carolina is the weakest point now, and Mr. Kimball is using every endeavor to get money to render it as humanly secure as the rest of the coast. Those who have the work in hand are fully competent to make the needed improvements, if only they have the means given them. They want assistance, and it would seem particularly appropriate that we, a society devoted to travel, should do what we can for them by word or deed.

The coast from Maine to Florida is divided into seven districts. Each district is in charge of a superintendent, and the large ones have, besides, an assistant. It is the duty of the superintendent to be always on the go, inspecting his crews and stations, and drilling his men.

The districts are as follows:

No. 1. Maine and New Hampshire, 6 Life-saving Stations, 1 building.

No. 2. Massachusetts, 14 Life-saving Stations, 1 building.

No. 3. Rhode Island and Long Island, 36 Life-saving Stations, 1 building.

No. 4. New Jersey, 40 Life-saving Stations.

No. 5. Delaware, Maryland, and Virginia to Cape Charles, 11 Life-saving Stations.

No. 6. Virginia from Cape Henry, and North Carolina, 10 Life-saving Stations, 13 building.

No. 7. Florida, 8 Houses of Refuge.

The Eighth, Ninth and Tenth Districts are on the lakes, and the Eleventh is the coast of California and Oregon, furnished with 11 life-boat stations.

There are three classes of stations:

First, Life-saving Stations—Situated in localities remote from settlements, furnished with every possible appliance for rescuing the

ship-wrecked, and ministering to the immediate necessities and comforts of those saved. They also furnish quarters for the keepers and crews. On account of the limited means at the disposal of the management, the stations are manned only during the winter months. That this is unwise, although necessary, the Huron disaster showed. The crews now consist of six surf men besides the keeper.

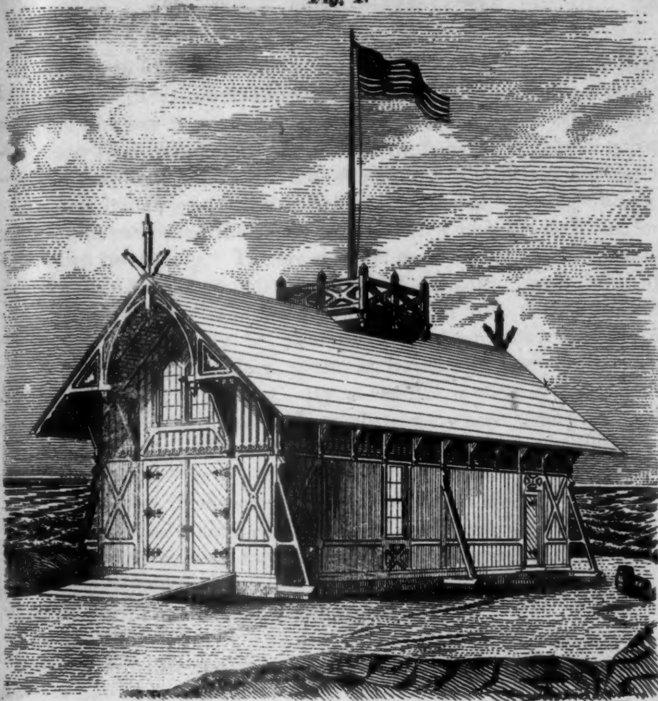
Second, Life-boat Stations—Located near settlements where volunteer crews can easily be summoned. These are furnished with boats and such other appliances as the nature of their situation calls for. The stations of the Eleventh District are of this nature.

Third, Houses of Refuge—Situated in desolate localities, where the general state of the coast does not call for the use of the appliances furnished to the other class of stations. These are intended to afford shelter to those who may come ashore. They are provisioned and supplied with medicines, blankets, beds, &c. Small boats are placed in them, with which to reach points of safety or passing vessels. A keeper, with his family, resides in them.

Some of the stations are connected with the Weather Signal Service, by telegraph, some are being furnished with telephones, and are used as warning posts for passing vessels; this feature should be extended to all of them, and if the international code flags were added to the outfits, vessels could communicate with any part of the world from many points on the coast. A shore line of telegraph should connect the stations with each other, this line being besides fitted with alarm boxes on the poles, similar to those used by our fire department, would serve for the patrols to send in signals of distress from wherever they might be.

The small surf-boat is used at almost all the stations. Our coast is so sandy and rugged that it is impossible to transport life-boats weighing generally four or five thousand pounds. The surf men are also familiar with this style of boat, and seem to place more reliance in it than in any other. The smallness of the crews renders even this very difficult of transportation to any distance. Where they can be hired, horses are used, but where they are most wanted they cannot be obtained. It is recommended that four horses be kept at the stations on the most exposed and desolate parts of the coast. The patrols could ride two of these horses, the other two being always in reserve to bring out the apparatus.

Fig. 1.



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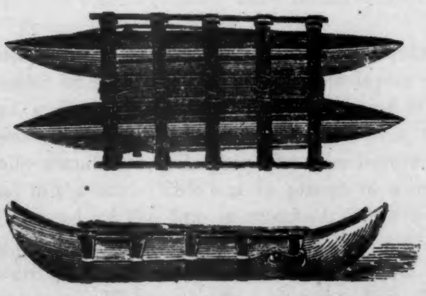

Fig. 1. EXTERIOR VIEW OF LIFE SAVING STATION.
Fig. 2. RIDER LIFE RAFT.

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The men, as we have before stated, are employed for only a part of the year. This necessitates the breaking in of new crews every season. The pay is small and the work most arduous, which prevents men from reshipping. It is now proposed to regularly enlist the men, employing them in the off months in drilling, making a coast road, building stations, repairing apparatus, putting up telegraphs, and patrolling the coast, in case of a possible accident, or to prevent smuggling. The crew, as it now stands, is too small. Two men are always on patrol; in case of an alarm, one or both of these will be absent. The beats at present, in some localities, are longer than can possibly be watched by one man, often reaching a length of eight miles. Then, again, no lee-way is left for the sick list, or unavoidable absence. By a regular system of enlistment good crews could be obtained from districts where plenty of men are to be found, and transferred to those where the material is poor.

The appliances furnished at a complete station are:

A surf-boat fully equipped, boat carriage, mortar and appliances, pin board with line, sand tarpaulin and pegs, whip and hawser. Sand anchor, tackle and crutch.

Signal flags, lanterns and coston lights.

Beach light.

Life car, life raft and breeches buoy, medicines, tools, provisions, blankets and beds, also

A hand cart, in which those of the above-named articles, except the boat, that are required at the scene of action, are conveyed.

The boat is used when advisable; chief reliance, however, is placed in the line.

The method of proceeding is as follows: three hundred fathoms of line are coiled on a pin board, the different layers running clear of each other, and paying off the pins. This board is covered by a box, when wanted for use. The box is turned over, the pin-board being carefully withdrawn, guided by the false bottom. This leaves the line faked in the box. This box is placed to windward of the mortar, and the end of the line is attached, either by means of a spiral spring, or directly, to the projectile. The latter method has proved the most certain; care is taken to wet the end of the line to prevent its burning. The projectile is elongated in shape, the line

coming to the outer end, which protrudes from the muzzle. On starting, the projectile first turns over, so as to bring the line to the rear. The mortar is trained so as to point between the masts of the vessel. Should the first shot miss, the line is run in and coiled on the tarpaulin, which is pinned down to the ground with tent pegs.

The line, having reached the vessel, is hauled upon by those on board, the whip block having been attached to the shore end. Attached to the block, is a board or bottle with directions in English, French and German for making it fast. The block is made fast as high above the deck as possible, by means of its tail. The next operation is the hauling out of the hawser; done by those on shore, who have first taken the precaution to join the two ends of the whip. The hawser is made fast to the mast above the tail block. As soon as "all fast" is signalled from the vessel, the shore end is hauled hand taut. The sand anchor, two pieces of heavy plank crossed and fitted with an eye-bolt at the intersection, is planted in a trench. The crutch is then set up; the hawser being taken over its crotch. The tackle is clapped on to the hawser, and hooked to the sand anchor. If the vessel is rolling, it is necessary to tend the tackle, if not, it is set taut and belayed. The life-car, which is like a small life-boat with a cover, is then suspended to the hawser, hauled out to the wreck by means of the whip, the bight of which is made fast to a traveler; when loaded, it is hauled ashore again by the other part of the whip.

The car is necessary when there are landsmen, women, children or invalids to be conveyed; for seamen the breeches buoy is used. This is a large cork life preserver with a pair of canvas breeches attached, the man sitting in it. This buoy may be used on the whip alone if necessary.

The rescued persons once ashore are taken to the station and cared for.

The records of the service show this year that within the limits of the operations of the service 171 disasters to vessels. On board these vessels were 1,557 persons. The estimated value of the vessels is $1,879,063 and that of their cargoes $745,672, making the total value of the property involved $2,624,735. The number of lives saved was 1,331 and the number lost 226. Of the latter number 183 perished in the disaster to the United States steamer *Huron* and the

Fig. 1.

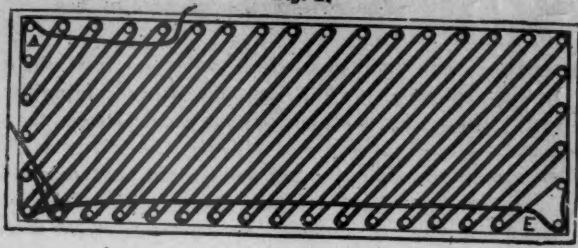


Fig. 2.

Fig. 3.

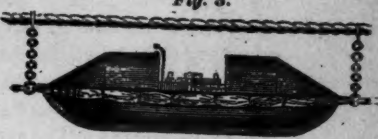


Fig. 4.

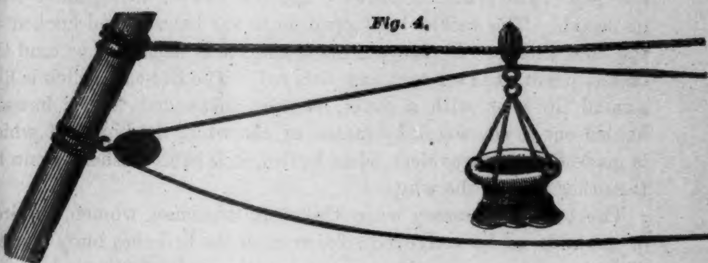


Fig. 5.

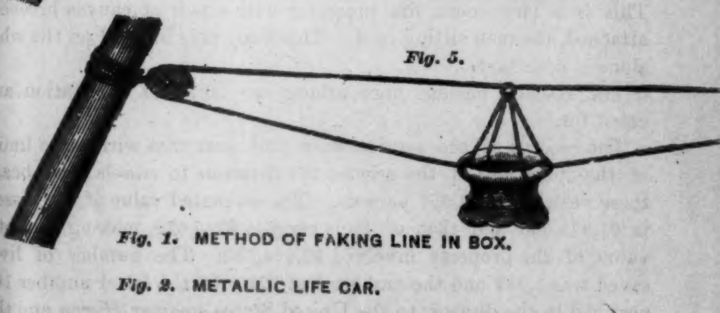


Fig. 1. METHOD OF FAKING LINE IN BOX.

Fig. 2. METALLIC LIFE CAR.

Fig. 3. SECTION THROUGH METALLIC LIFE CAR.

Fig. 4. BREECHE S BUOY USED WITH HAWSER.

Fig. 5. BREECHE S BUOY USED ON SHIP.

steamship *Metropolis*—98 in the former and 85 in the latter. The number of shipwrecked persons sheltered and succored at the stations during the year was 425, the total number of days' relief afforded them being 832. The total value of property saved is estimated at $1,097,375, and the amount lost at $1,527,360. The number of disasters involving the total loss of vessels and cargoes was 595. These statistics show that the disasters of the present year were greater in number and severer in character than the service has ever before encountered, a fact established by the record of 171 disasters within life-saving limits against 134, the highest number of any former year, and of 59 vessels and cargoes totally lost, in contrast with the highest antecedent record of 34. A large proportion of the loss of life is made up, as before stated, of the 183 persons who perished at the wrecks of the *Huron* and *Metropolis*, the first wreck occurring before the opening of the stations under the provisions of law, and the latter between two stations at such a distance from either as to greatly hinder successful operations, conditions which had long been indicated by the officers in charge of the service as pregnant with fatality. There were four other wrecks, involving the loss of ten lives, which occurred when the stations were closed, and one other disaster, involving the loss of four lives, happened at a distance which made prompt assistance impossible. The General Superintendent shows that the number of lives lost fairly and legitimately within the scope of the effective operations of the service was but twenty-nine, and further shows that this loss of life was unpreventable by human efforts. The particulars of each case are given in detail.

Thus far the lines have been sent from the shore to the vessel, and Lieutenant D. A. Lyle, of the Army Ordnance Corps, who has been for some time experimenting for the service, has succeeded in producing a bronze, muzzle-loading, smooth-bore gun, of which he recommends three calibres 2 in., 2.5 in., 3 in., to be used according to the ranges required in the different parts of our coast. This gun with its carriage and shot weighs a little over 200 lbs, and has reached a maximum range of 695 yards, far more than any other has ever succeeded in doing. The shots weigh 13, 19 and 23 lbs. respectively. The line used is waterproof braided linen thread, very carefully selected, made by the Silver Lake Company. One of

the great advantages of this gun and projectile is that it does not allow the line to sag to leeward as much as its predecessors, and therefore gives greater accuracy. Rifled guns cannot be used with lines, as the rifled motion would twist them and cause them to foul.

Mr. Edmund S. Hunt, of Weymouth, Massachusetts, has invented an apparatus for throwing lines, which, under certain circumstances, principally on account of its portability and compactness, might be of great service. It consists of two hollow metallic cylinders, closed at one end. In each of these is coiled away part of the line to be thrown. One of these cylinders, containing enough line to reach the object, is loaded into a very light gun, also of his invention; the other is held in the hand of the operator. When the gun is fired, the cylinder leaves it and turns over, paying out the line as it goes. If there should not be enough line in it to reach the object, the line in the second cylinder acts as a reserve. The theory is very good, and if the gun had been as good the system would probably have been adopted. You have all seen a hose-cart at fires. When the hose is first attached to the hydrant, or engine, and the reel dragged away, paying out the hose as it goes, it is an easy operation; but if the hose-cart is taken to the scene of the fire several blocks away, and then the hose unreeled by hand, and the end dragged to the hydrant, the operation is much more difficult. This is the principle of Hunt's shot, and that of all instruments of a similar nature where the line is payed out from the movable body, and not dragged by it.

In all the life-saving services to which we have referred, the lines have been sent from the shore to the ship; it is conceded by all that this is not the proper way. The line should come from the ship; but, until we can force shipowners and governments to provide their vessels with some means of sending lines, and even having them to send, we must continue this method.

When a ship goes ashore the wind is generally blowing hard on shore, and the sea setting in the same direction; it is true that there is generally more or less of a current running parallel with the beach; therefore, from the ship we have two elements acting in our favor. From the shore we have this against us. From the shore we have only a small target, the ship, to fire at. If she comes in and strands bows on, it is smaller, even, than when she presents her

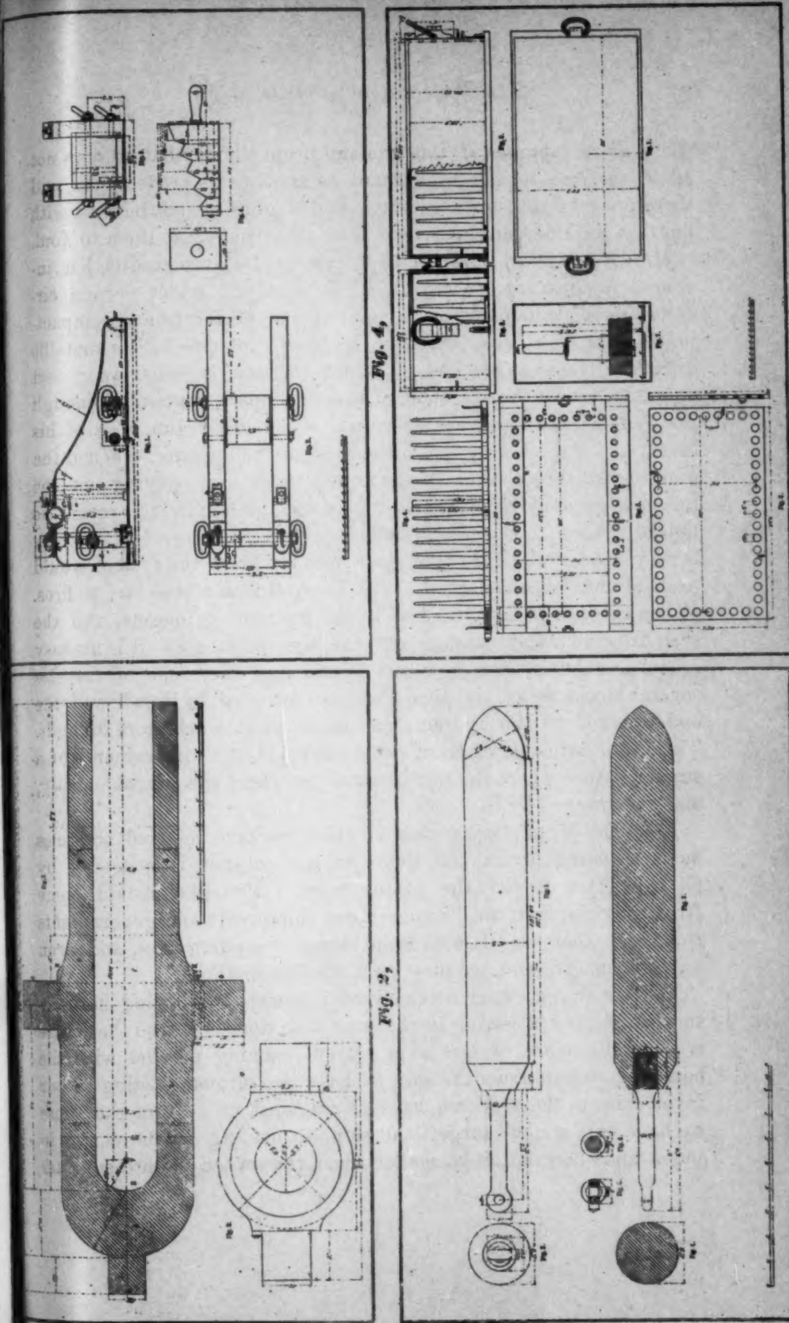


Fig. 1. LYLE GUN. Fig. 2. PROJECTILE. Fig. 3. CARRIAGE. Fig. 4. FAKING BOX.

JOURNAL, VOL. XI, AMERICAN GEOGRAPHICAL SOCIETY, 1879.

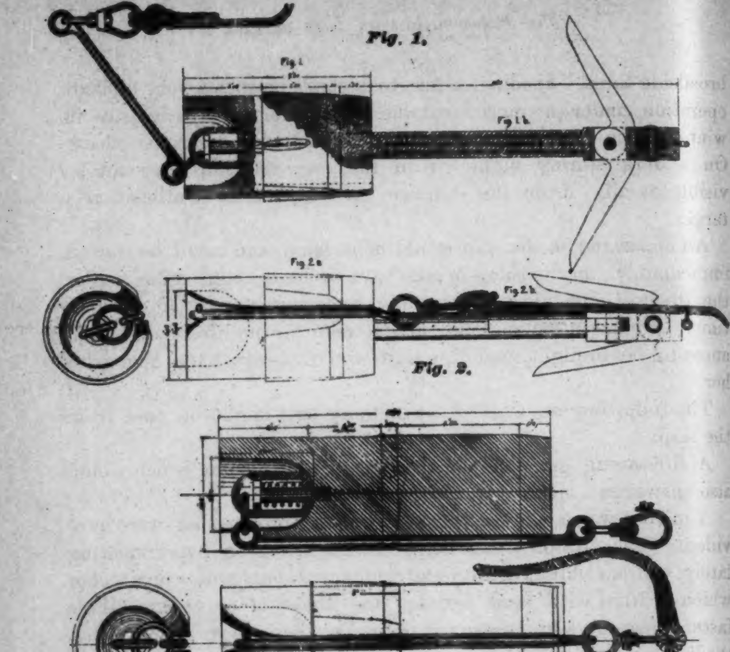


Fig. 1. FOLGER'S GRAPNELL SHOT.
Fig. 2. FOLGER'S LIFE SAVING SHOT.
Fig. 3, CHANDLER'S ANCHOR SHOT.

broadside to us. Sending a line to a ship's bows is a very difficult operation, under the most favorable circumstances, especially so in winter, when the bows are generally covered with an armor of ice. On a dark stormy night, or in the fog, the ship may not be visible at all. From the ship we have the whole continent as a target.

An apparatus on the ship would be at hand, and could be started immediately; on the shore it may have to be brought miles, under the greatest difficulties, consuming sometimes hours of precious time. Furthermore, on some coasts there are no life-saving appliances to be brought, and the ship would always have hers with her.

The following are some of the methods that might be used from the ship:

A life-saving gun, similar to those used on shore, which would also answer as a signal gun for a merchant vessel.

A man-of-war could use her own guns if proper shot were provided. Capt. Ralph Chandler, U. S. N., has been experimenting lately, and has obtained excellent results with our guns, using a shot which is fitted with arms forming the flukes of an anchor; these fasten themselves in the ground or rocks where they land, so that the line may be hauled upon without the aid of persons on shore. This would be a great advantage on uninhabited coasts.

Lieut.-Comd'r. W. M. Folger has also been experimenting in the same line, and has obtained excellent results.

If a shot is not provided, a length of chain can be wound up into a ball of the proper size, and thus secured the line is made fast to the end of the chain. An empty shell with the line toggled in the fuse-hole might serve.

The objections to using a gun would be that when there was much motion on, or the seas washing over the vessel, or the vessel on her beam-ends, it might not be possible to get it in the proper position for firing. About eighty per cent. of vessels that go broadside on, heel to seaward.

Rockets might be used with good effects. With as weak a rocket as our common signal one, I sent a line four hundred feet last year. A small line fastened to the ramrod of a musket might be used for short distances. Captain Nares, of the English Navy, known to

you probably in connection with the voyage of the *Challenger* and the last Arctic expedition, proposes a large kite, made of canvas and spars and fitted with two lines, so that it can be guided up or down. To this I have added an anchor-tail. Such a kite would also be of use in communicating between vessels at sea where it was dangerous to lower a boat. A line fastened to a box or barrel might drift ashore.

An expert swimmer in a life-preserver, or on a mattress or bolsa might reach the shore in safety with the end of the line, if better means were not at hand.

Capt. James E. Jouett and Lieut.-Comd'r W. B. Hoff, of the Navy, have invented an apparatus which will probably be adopted in the service. It consists of a float carrying a reel, on which can be wound 6,000 feet of line. At the forward end is a large rectangular shield. This shield is so placed that, no matter how the float turns, one corner will always be up to act as a sail and one down to act as an anchor. The weight of the apparatus is about 200 pounds. It is intended to be carried one on each side of the vessel, hung over the side at sea, the end of the line being made fast on board. No matter how the vessel grounds, one at least will be in position for use. It is let go by a detaching apparatus and starts for the shore paying out the line, which, being heavier than water, sinks and lies along the bottom; this prevents drifting. As the line pays out from the float there is no retardation. The sail-point is acted on by the wind, which would force the whole machine across any moderate coast-current. When it gets into shallow water the lower point keeps it from being carried back with the undertow; each succeeding wave carrying it higher on the beach, where it is picked up by those on shore. If the coast is uninhabited it acts in the same manner as the anchor-shot already referred to. A ring-buoy is to be attached to this float, so that it can be used at sea to succor a person overboard.

Another float is that of Dr. Newell, of Asbury Park, New Jersey. This is a cone, which floats on its side, point foremost. Near the rear end is a concave diaphragm, in the centre of which is secured a bar which passes to the rear through a cross-support and projects some distance beyond, having an eye in its end; to this eye is attached the end of the line. The buoy is put overboard, and the wind

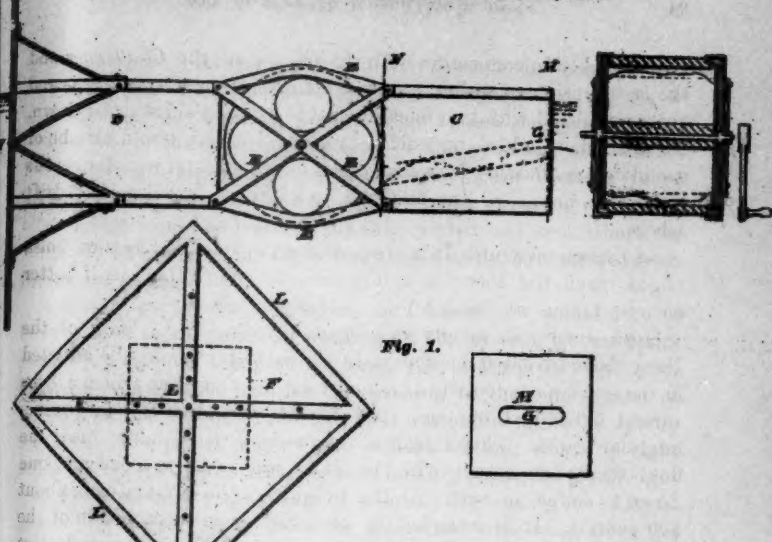


Fig. 1.

Fig. 2.

Fig. 1. JOUETT—HOFF APPARATUS.
Fig. 2. LIFE SAVING BY MEANS OF ROCKET AND BREECHE S BUOY.

and sea acting on its rear end it is driven towards the shore. When its reaches the coast-current it is steered across by hauling on or slacking the line from on board. This causes the current to act against one or the other interior faces of the cone and makes it act like the swing-bridges still to be seen on some of our Western rivers. The line once ashore, there is a good chance of saving all hands. Of course it would be better if the ship carried and sent ashore the whip and hawser. A life-car or buoy could easily be contrived from the means at hand.

And now, gentlemen and ladies, as I know you would like to have a look at the practical working of our system, let me invite you to put on your warmest clothing, your waterproofs and your thick boots, and come with me this evening to the lonely coast of North Carolina, not quite so lonely as it was on the night the *Huron* was lost. The patrol man of the nearest station, which is eight miles off, is now there. But see, he is looking seaward. He thought just now that he saw the gleam of a light. He was right. Almost blinded by the salt spray from the sea mixed with sand from the beach, he is able to make out a vessel's lights, and to add to his certainty, there goes her gun. She is heading right in for the breakers and will ground in a few seconds. The patrol burns his Coston light to show them that they are seen. More he cannot do until he summons assistance. He starts for the station, and after weary hours of toiling, which can only be appreciated by those who have tried such a journey on our coast in a winter's storm, he reaches his destination. The alarm is given, and in a few minutes the crew start with their apparatus. Six men, all told, one being far away to the westward on patrol, and cannot be recalled, and one of this small number is already exhausted by his previous endeavors, dragging a hand-cart weighing, with its load, over 1,700 lbs., almost 280 lbs. per man, 180 being the utmost allowed, on level roads, as the traction of one man, with the wheels, whose tires are five inches broad, sinking several inches into the sand. After tugging through sand, and floundering in mud, sometimes entirely halted by the storm, at all times straining every muscle, they reach the scene of disaster. There they find that hours before the vessel has gone to pieces, and all that they can do is to save a few corpses from the surf. Could human beings have done more with the means at

hand? And when we know that these men get for such work a sum of $1.33 a day for five months in the year, can we say that they have not fully earned it? Yet with all this, to morrow the opinion will go forth, from the pens of a hundred well-clothed and comfortably-lodged gentlemen, that the U. S. Life-saving Service is a fraud, the organization is bad, the officers are inefficient, the crews are poor, and the patrolmen negligent in the performance of their duties. Now, should these same gentlemen devote their energies to assisting the Service, instead of belittling it, in the popular opinion, how much could be gained. The lesson would be taken to heart; public sentiment would come to the aid of the organization; appropriations would be increased, and everything done to make such another accident impossible. With such aid to carry out the plans already matured, we should have another story. The patrolman, two, or at most three miles from his station, would have dismounted from his horse; going to the nearest telegraph pole, he would have sent in the alarm; burnt his light; and watched for the line to come ashore; he would then have attached the line to his horse, and with his aid have hauled in the whip. In the meantime, the crew, with the apparatus drawn by two good horses, would have arrived by an excellent coast road made by the men in summer. The hawser would then be sent out, or one might be hauled ashore from the ship if it could be gotten at on board. The car then attached and hauled out, the horses being used to assist, it would then come ashore; and when opened who knows but what young Solon, son of Congressman Solon, and Mr. Hardcash, the great banker and beloved friend of Senator Demosthenes, might not be found comfortably ensconced therein? What a comforting thing it would be to Messrs. Demosthenes and Solon to think that they had both voted for the increased appropriation, and a bill for the further perfecting of the United States Life-saving Service. Who knows but we ourselves, or our friends, may some day need the life-car?

LIFE SAVING BY MEANS OF LIFE CAR.

MODERN OCEAN HIGHWAYS.

By A. A. Hayes, Jr., Esq., F.R.G.S.

I am aware that the ocean highways, about which I shall have the pleasure of speaking to you this evening, come very much more within lines which are familiar to most of those present than the remoter regions about which you are in the habit of hearing in this place; but they have this advantage, that if the genius of travel be developed in this country as much during the next ten years as during the last, it is more than likely that many of you will put my descriptions to a practical test. I desire to say in advance that it is of course impossible for me to claim entire originality for all that I shall tell you. I have not been, for instance, to Australia, or over some of the byways to which I purpose alluding; but the great bulk of my information is derived from personal experience. I shall also apologize in advance for any departure which I may inadvertently make from that serious key in which I am aware that a discourse before a learned society should be pitched. I shall endeavor to state facts, and it is indeed in this respect that I shall claim a certain originality for my treatment of this subject. Most voyagers in these, days seem irresistibly impelled, after passing a certain distance from their homes—to draw more or less upon their imaginations for the details which they furnish. I know of no one of the many books and collections of letters that are before the public—referring especially to the circumnavigation of the globe—in which absolute regard is had throughout for the simple truth; while on the other hand, there are many which seem modeled on the highly entertaining but scarcely veracious narratives of Monsieur Jules Verne. I have in mind a meeting which took place some years ago, between one of these travelers and myself. He was a writer of note, and a Doctor of Divinity—by-the-bye—and we met in San Francisco, each on his way around the world. I was going to say that he was bound to the East, but I must speak with great caution, for there is no place in the world where one becomes involved in such hopeless contradictions and paradoxes about the points of the compass as in this same San Francisco. I should have said that he claimed

that he was bound East, but I had just come from the countries to which he was journeying, and could most distinctly state that the setting sun had shone in the stern windows of the steamer's saloon as we sat at dinner each afternoon. Then they certainly said in San Francisco that he had come *from* the East, and that I was bound by rail *to* the East. I might have quoted to him what the engine from Sacramento is reported to have said to the engine from Omaha, when they met—"Pilots touching, head to head," at Promontory Point, in Utah, when the last rail of the Pacific Road was laid:

"You brag of your East, you do;
"Why, I bring the East to you.
"All the Orient, all Cathay,
"Find through me the shortest way,
"And the sun you follow here
"Rises in my hemisphere;
"Really, if one must be rude,
"Length, my friend, ain't longitude."

This, however, was an open question, and we readily agreed to disagree thereupon. Then he kindly gave me the schedule of his journey, which he was furnishing as special correspondent of a well-known journal. He began—New York to San Francisco, six days and some hours. Now you take the train from New York at half-past eight, say on Monday evening, and if all goes well, you can enjoy your California fruit and coffee at the Palace Hotel, in San Francisco, at about the same hour on the seventh evening. As San Francisco is four hours behind New York, it is pretty clear that you have actually been seven days and four hours in making the journey. *Vice versâ*, you leave San Francisco at eight o'clock in the morning, and arrive in New York at quarter past seven; and as New York is four hours ahead of San Francisco, your actual traveling time has been about six days and twenty hours. This latter fact, of which due notice is taken in the time-tables, furnished my friend with a basis for his first entry. Then, San Francisco to Yokohama, 22 days. I had here to remind him, that even if he risked taking the very last train which would catch the steamer, he would arrive at San Francisco at evening, and not sail until the next noon; and he ought to put 18 hours in there. Similarly, I showed him that he was ignoring the time required at Yokohama for the trifling forma-

lities of discharging cargo and taking in coal; matters of from 24 to 48 hours. It was at Hong Kong, however, that our differences culminated, as the absurdity of counting on an instantaneous connection there for the South was too much for my patience. Although there is no doubt that steamers belonging to the effete despotisms of Europe should regulate their movements entirely by the arrival of the American mail boats, the Peninsular and Oriental Company, and the Messageries Maritimes, with the obstinacy and self-sufficiency of such effete despotisms, insist upon arranging their weekly departures to suit themselves; so that the special correspondent might have six days to wait, and he should fairly allow at least 3½.

I may as well complete this preliminary digression by stating the least time which any person would probably consume in making the circuit of the globe, who was reduced to the necessity of attempting such a useless performance:

New York to San Francisco	7	days.
At San Francisco, say	1	"
The trip between Yokohama and San Francisco was once made in between 14 and 15 days, but it would not be safe to allow less than	16	"
At Yokohama	1	"
Yokohama to Hong Kong	6	"
At Hong Kong	4	"
Hong Kong to Marseilles	36	"
At Marseilles, and Marseilles to Liverpool	2	"
At Liverpool or London	2	"
Liverpool to New York	10	"
Total	85	days.

By going across Egypt by rail and to Brindisi instead of Marseilles a day might be saved. I need hardly say that I should earnestly dissuade any one from attempting to carry out this schedule.

Anything like even a general mention of modern ocean highways would, of course, far transcend the limits of both the time allotted me, and your patience. I shall therefore describe some of the more important, with allusions to subsidiary and collateral ones.

It is not necessary to say much of the various routes between different ports of Europe and sundry points on the Eastern coast of the Americas from Hudson's Bay to the Straits of Magellan, and to the Atlantic islands; nor of those between different points on the Eastern American coast; nor of the well-known routes for sailing vessels from Europe and America around the Cape of Good Hope to Eastern Africa, the Persian Gulf, Hindostan, Ceylon, and the Bay of Bengal; nor of those by the Straits of Sunda to Java, Sumatra, Singapore, Siam, Saigon, China, Japan, Eastern Siberia, and Kamtschatka; nor again, of that to Australia and New Zealand.

There has been much of interest in the advancement of navigation in the broad Pacific. It is not many years since the destinations of vessels bound "around the Horn" were mainly the West Coast of South America, Panama, Mexico, the Pacific islands, and the many and divers haunts of the whale. The conquest of California by the United States in the Mexican war, and the subsequent discovery of gold, sent many sailing vessels by this same stormy route, and many steamers through the Straits of Magellan, to the little Spanish settlement of Yerba Buena, where now stands the fine city of San Francisco. There followed the inauguration of the Isthmus and Nicaragua transits and the services of steamers on both sides.

Next came the opening of Japan to commerce, and the realization that Yokohama was the natural objective point for a line from California; a conclusion which was emphatically clinched by the construction of the Pacific Railroad.

There is something in this connection to which I desire to call your attention. Japan itself and the route thither were opened by the United States; and if one may judge by recent occurrences, it is fortunate that these openings took place when they did, or they might never have taken place at all. We sent a formidable fleet, under Commodore Perry, to open communication forcibly, if necessary, with Japan, and it is proper to assume that we did not take all the heavy responsibility, and incur the heavy expense without deliberation, and full confidence in the justice of our action.

We did this because, as we declared, *no nation had the right to exclude citizens of other nations from her shores.* It was this cardinal principle which the Commodore was to maintain at the mouth

of his eleven-inch guns and Dahlgren howitzers. On the way to Japan the fleet stopped at China ports for supplies, and the "moon-eyed lepers," as it is now the fashion to call them, came to view the fire-ships of the Barbarians of the Flowery Flag with their accustomed stolid indifference. They ought, doubtless, to have changed their minds when they heard of the dictum, so distasteful to them, which said fire-ships were to enforce; and they must have learned with keen satisfaction that, within a quarter of a century, our Representatives at Washington, with a brutal and self-stultifying haste, have pitched the Declaration of Independence into the gutter, and have committed their country to the statements that this was all a mistake, that we did not mean anything of the kind, that what was sauce for the goose is emphatically *not* sauce for the gander, and that a nation *has* an undoubted right to exclude the citizens or subjects of another power from its borders (always provided that we are *sure* that the other won't fight), on the ground that there may be a chance of securing thereby, for one party or the other, a small fraction of the "working-man's vote." If any one tells you that the Chinese Government is angry or distressed at the action of Congress, I counsel you not to believe him, for I know of few things which could bring greater joy to the breasts of the officials of the Tsung-le-Yamun or Foreign Office, than the news that we had utterly abandoned the principle which we had supported so stoutly twenty-five years ago. This matter is quite apropos of Ocean Highways, inasmuch as they are in process of occupation by the Chinese, but I leave it with two predictions. One is, that we shall see ere long the crowning humiliation of our carrying trade, in the arrival of a Chinese mail steamer at San Francisco; and the other, that the passage of the Anti-Chinese Bill, happily described as the "first step in the Mongol conquest of the world," will inevitably, like chickens and curses, come home to roost.

The opening of the Pacific route to the Orient was an enterprise deserving of great praise, and it has done very much for the commerce of the world, but it has a most powerful competitor from that remarkable achievement, the construction of the Suez Canal, due, as you know, to the wonderful skill, energy and perseverance of that great executive manager, Ferdinand de Lesseps. The scoffings, and predictions of the total failure of this work, with which the English papers were filled during its construction, read very much

to-day as do the Cassandra-like forebodings and complacent chucklings of the same papers during our civil war; but, while they scoffed and prophesied, Mr. de Lesseps and the Khedive worked, and I can readily imagine that when the former, sitting in his comfortable bureau, read from his returns that the contributions of the English to his shareholders' dividends in the way of tolls exceeded all others, and then received a telegram saying that Earl Beaconsfield had gone down to borrow the money of the Rothschilds with which to buy out all the Khedive's shares, he thoroughly enjoyed the realization of the revenges which the whirligig of time had brought him.

I notice the Suez route as a formidable competitor of the American one, because it is freight, and not passengers, which must support a line, and this is carried in steamers through the canal without any transhipment from China and Japan ports directly to London and New York, at rates which are comparatively very low, and would not remunerate the combined sea and rail conveyances. For passengers and mails, however, and certain classes of freight, we offer unapproachable facilities from this country to Australia (by the line recently established), Japan and China, and competitive routes from England to the former two.

I shall now ask you to join me in some "fireside travels" over some of these principal highways, and we will first, if you please, go from San Francisco to Australia. Passing out through the Golden Gate, between Point Bonito and Point Lobos, we steer for the Sandwich Islands, and should arrive at Honolulu in about seven days. Leaving this port again, we proceed to New Zealand, and reach Auckland in, say, fourteen days more. Thence to Sydney is only about four. From hence one can go on around the world, by two routes—either by the old one to Melbourne and King George's Sound, and thence to Point de Galle, in Ceylon; or by the eastern coast of Australia, and through Torres Straits to Singapore; joining in both cases the so-called "overland route," which will be described later on.

Returning to San Francisco, we will now take a larger steamer, and shape a course towards Japan. It is a lonely track, a sail being rarely seen except when near land. In the days of the old sidewheel steamers—the most comfortable, if not the swiftest, that ever floated—the event of the voyage was the meeting with the sister

ship. The regularity of their movements was such that the time of this meeting could be predicted by the captain with great accuracy, and a very dramatic affair it was. The light or the smoke would be made out dead ahead, the great ships would come up alongside of each other, the homeward bound would send a boat for the exchange of papers and letters, and then both would go on again. Then comes the crossing of the 180th meridian, with its curious effect on the length of the passengers' lives. I hope that I know my duty in regard to this audience too well to open such a Pandora's box as is a discussion of this matter, for it has no rival in its power to disturb the happiest and most harmonious gatherings, and hazard the continuance of the warmest friendships. I will, therefore, merely state the fact that in going to Yokohama a day is dropped out, and in coming from it a day is put in; and I will then content myself with a description of the plan conceived by a friend of mine for putting this fact to a practical use. He proposed to establish a business office on the 180th meridian. When a draft was presented for payment he would go to the other side of the building and say that it was not due until next day, and next day he would declare that it was overdue, and not pay in either case. Unfortunately for the success of this scheme, there is on this meridian, through its whole length, from the regions which Lord Dufferin so happily described in this hall as "lying under Arcturus and lit by the rays of the Aurora," to the mysterious Antarctic continent, not a square foot of solid earth.

In due time Cape King is sighted, and the steamer runs into the Bay of Yedo and comes to anchor off the foreign settlement of Yokohama. Having discharged and received cargo and coaled, it will proceed south through Van Dieman's Strait, near a volcano which was showing signs of activity when I last saw it, over to and through the Formosa Channel and to Hong Kong. It will be more interesting to reach the same destination by another route, and this will give us time for two short excursions before sailing. I choose two out of many which are possible and profitable in this beautiful and most interesting country. We can first take a capital little narrow-gauge railroad some twenty miles north to Yedo, the ancient capital of the Tycoon (now called Tokio); and here, again, we can select but one object of interest—Shiba. This was, only a few years ago, a quiet, sombre, dignified retreat in the middle of

this bustling city, where sleep the Tokugawa clan—the family of the Tycoons or civil emperors, now superseded by the Mikado, formerly the spiritual monarch. A certain iconoclastic spirit is inseparable from the wonderful changes which have taken and are taking place in this country, and the results are not happy in an æsthetic point of view. We ought not to complain if the officials pull down the temples to furnish good timber for the navy-yard at Yokoska, which we passed in coming up the bay; but I saw with great regret that the really solemn stillness of this spot had been disturbed by the abandonment of the restrictions as to entry, and by the introduction of booths and the hum of talk in the immediate neighborhood of the beautiful temple to the "Black True Buddha" (of which I shall show you a picture). Again, we can journey south by the Tokaido or great national road, turning off at Fujisawa to visit the image of Daibootz (Great Buddha), with its calm bronze face and picturesque surroundings. Then we go to Odawarra, beyond which wheels are not practicable—the "King's Highway"—running up a gorge and climbing stone steps. Gradually ascending, and passing Lake Hakone, at an elevation of about 2,500 feet, we come to a place where the Hakone range breaks down to a sharp edge, at a point called the Tomi-Tomi Pass. Laboriously climbing this, we see, as our eyes come up to the level of the ridge, a sight never to be forgotten while life shall last, and sure to suffer in any description which I can give of it. We are say 4,000 feet above the level of a plain, with the sea washing its eastern shore—to which plain we look abruptly down. At its southern extremity rises, in simple majesty and picturesque grandeur, the great sacred mountain—the matchless Fusiyama. Try to remember that—unless you have journeyed to Oregon to view our Shasta, which Mr. Bierstadt has kindly described to me—you have never seen a high mountain rising from a plain level with the sea. Think of the peaks environing Mont Blanc, and remember that when you see Pike's Peak you have already surmounted an elevation of some 6,000 feet, and then try to imagine this almost perfect cone, 14,000 feet, in plain sight from base to summit. Such is its fascination, that we are sure to miss the Shanghai steamer unless we tear ourselves away, hurry back to Yokohama, and embark. We follow the track of the Hong-Kong boat (and not only the American, but the French and English lines ply here) as far as

Oosima, and then turn into a passage leading to the famed Inland Sea. In about thirty-six hours we arrive at Kobe, or Hiogo, whence a railroad runs to Osaka. Thence we sail through a lovely sea, or succession of seas—of which you have often heard—through the Strait of Simoneseki, where the "Wyoming" had her fight some fifteen years ago, and so on to Nagasaki—entering a harbor which is, beyond a doubt, one of the loveliest spots in the world. I will say, here, that I must resist the temptation to dwell on the beauties and features of interest at this and many other spots which we are to pass. I should not know where to stop; so that I shall rely on the pictures, and my brief comments thereon, to give you some idea of the characteristics of the various points. Between Japan and China lies the Yellow Sea, which is crossed in about forty hours; and then the change in the color of the water, similar to that noticed in the Gulf of Mexico, shows that we are approaching the mouth of the Yangtze Kiang; about fifty miles above which comes in the Wongpoo River, on which is Shanghai, the most important port of China. The foreign town has been rightly called the "Model Settlement," and is an interesting place in many ways. It is situated on the dead level of the Yangtsze Delta, and surrounded by damp rice fields; but the foreigners have made it a pleasant residence. Steam lines run hence to Chefoo, Tientsin and Newchwang on the north, the ports on the Yangtze, Japan on the east, and to the coast ports to the southward—Hong Kong, Canton—and on to the west. One has been projected, also, to Wladivostok (the Russian station nearest to China) and the mouth of the great Amoor; and I would gladly tell you, did time permit and were it germane to my subject, of the curious advance which Russia is making in these regions. You will, at any rate, be glad to have me point out the course of the telegraph wires in this portion of the East. One cable is laid to Hong Kong, where it connects with the China Submarine Line to Europe. Another is laid to Nagasaki, where it connects with the Japanese Government's lines. A third is laid from Nagasaki, through the Straits of Corea, to Wladivostok, whence a special line was constructed to meet the Irkutsk and Amoor system, and thus give an alternative route to Europe. Mails, passengers and freight are conveyed from Shanghai to Europe by the weekly services of the "P. & O." and French companies; and, as the latter send their large steamers through the

canal, we will choose one of them. Leaving the river, we run through the islands of the Chusan Archipelago, and then down the coast and by the Lyeemoon passage into the harbor of Hong Kong. You are aware that this island is a British possession and colony, also a naval and military station. Hong Kong means the Island of Sweet Waters, and it is a beautiful place, as tropical places go. The town is built around the base and on the sides of terraced hills, and the Victoria Peak towers over it. From this port steamers run to Canton (a trip of about eight hours); the old Portuguese town of Macao; Manila, and the lower China Coast ports, Swatow, Amoy and Foochow. The P. & O. steamer runs direct to Singapore, but the "Messageries" boat stops at the French colony of Saigon in Cochin China. The running time to Singapore should be, with a fair monsoon, about six days. This important place, another British colony, is situated almost on the Equator, and has a perfectly even temperature from January to December. There is not a single glass window in the town, and one almost lives on his veranda. Here come in steamers from Australia, as before stated, and from Java. Then the route leads through the beautiful Straits of Malacca, and past the old settlement of that name, and near Acheen Head in Sumatra, where the Dutch have had to carry on such a disastrous campaign with the natives. The English steamers, but not the French, stop at Pulo Penang, considered the most beautiful island in the world. One can now go around the coast of the Bay of Bengal, to Rangoon, Maulmein, Akyab, &c., [the "rice ports," as they are called,] and finally reach Calcutta by this roundabout way; or he can go thither direct from Singapore. We proceed, however, a little north of west, and in about a week reach that quaint old tropical town—once Dutch, now English—Point de Galle, in Ceylon. In old days this was an important transfer point for passengers. The steamer from China, after touching here, went on to Bombay, while the larger steamer coming from Calcutta, and also touching here, went on to Aden and Suez. The same system was followed on the outward trip. Were one going to Calcutta, he entered his state-room at Suez, only to leave it at his destination, while his China-bound room-mate, as they entered Galle harbor, would be straining his eyes to see if the boat which was to take him on to Hong Kong had come in, with her hold full of opium, from Bombay. The homeward-bound China passengers (generally, I am happy to

say, jolly and cosmopolitan people, and excellent friends, after a fortnight's association), would find themselves at Galle regarded as interlopers by the Bengal "qui-his," as they are called, or high and mighty Anglo-Indians. Before long, however, all became pretty good friends. In common with many others, I myself have a most agreeable recollection of short stops at this spot, with "tiffins" of cocoanut curry and fried plantains in a stone-floored room in plain sight of the light-house and the Indian Ocean. It was here, as you know, that Bishop Heber said that

——"every prospect pleases,
And only man is vile."

We need but to drive to Wauk-Walla or the Cinnamon Gardens to be sure about the former, while you generally have what seems to you conclusive proof of the latter when you find that you have bought some glass sapphires or diamonds (this is believed to have been the Ophir of the Bible), or when you come to pay your bill at the hotel. I shall never forget a friend of mine who received his account in my presence. He read and reread it with deliberation, then walked up to the office with a mild smile irradiating his countenance. Pointing out the voluminous list of items and detestable "extras," he said to the proprietor, "I find two omissions here." "Ah, indeed; what may they be?" was the reply. "For looking at Mr. P—— ten rupees. For *not* looking at Mr. P—— fifteen rupees!" ejaculated my friend with a sudden vehemence.

Now, as you may know, a railroad has been built across India, and passengers from its Eastern presidencies travel in comfortable cars to Bombay and sail thence, thus avoiding the cyclone-swept Bay of Bengal; and all the French boats, as I have said, and some of the English go through from China. Leaving Ceylon, we cross the Arabian Sea, pass near the Island of Socotra, endeavor to avoid Cape Guardafui, the northeastern point of Africa, on which several fine vessels have been lost, enter the Gulf of Aden, and arrive at the town of that name. This station has long been known. In the fifteenth century the Portuguese fought for it, and the Turks in the sixteenth. In the eighteenth it was chiefly governed by native chiefs. Aden may be called a sentry-box of England on her road to India. The keeping open of this road being of most vital importance to her imperial interests, she neglects nothing which can serve in that direction; and in 1840 she took possession of this place, then

consisting of some mud huts roofed with mats, and containing some 600 inhabitants; now it is understood to have about 25,000. It is strongly and splendidly fortified and heavily garrisoned. You can imagine the appearance which it presents from the sea when I tell you that it is exactly like an enormous pile of coke. Connecting it with the main land of Arabia is a narrow strip of sand, commanded by heavy batteries, the rammers standing ready by the guns. The earth for the little garden, owned by the agent of the P. & O. Co., was brought in bags from Ceylon and Mauritius. The coast of Arabia is uniformly of a desolate and savage aspect, and the rocks look black and scorched; for it is in the interior that we must look for frankincense, gums, spices, dates and honey. Even the sparkling streams are lost as they approach the shores of this comparatively unknown country. Here come in steam lines from Mauritius and Reunion; and "Steamer Point" is quite a busy place with its coaling places, its curious general store kept by an enterprising Parsee, and its crowds of natives with their clay-besmeared red hair trying to swindle the passengers with their ostrich feathers.

Leaving Aden, we soon enter the famed Red Sea through the Straits of Bab-el-mandeb, meaning the "Gate of Tears," and thus fitly named by the early navigators, who found them perilous indeed. Here we pass the Island of Perim, which has a curious history. The French determined to take possession of it, and sent a vessel for that purpose, which stopped at Aden for coal. The officers were invited to dine by the British commandant, and as the generous wine passed round the board they talked somewhat freely of their plans. More wine was brought, and while it was in process of consumption, steam was hurriedly gotten up on the first available British vessel. When the Frenchmen were calling for soda-water in the morning, she was well on her way, and when they arrived at Perim they found the English flag already flying; and there it has flown ever since. What you see from the steamer is a small knoll with a lighthouse surrounded by a wall. Bearing this in mind, you then appreciate the merit of a description once given of it. Many of you know *Bradshaw's Guide*, the great manual of English railway time-tables, containing, as *Punch* said, (happily commenting on its eccentric and complicated arrangement), different classes of trains—trains which start but don't arrive, trains which arrive but don't start, and trains which neither start nor arrive. Having exhausted Great Britain and the continent, Bradshaw sought "fresh fields and pastures new," and published a "Guide to the East," the most impu-

dently inaccurate affair ever palmed off on a gullible public. This miserable little knoll is described somewhat as follows: "Perim, an island at the entrance to the Red Sea. In its harbor the navies of the world might ride at anchor. Supply of water inadequate; *hotel third rate!*"

None of the explanations of the name of the Red Sea are satisfactory or conclusive;—whether we trace it to sand, coral, or a plant which grows in the water, and yields a red color for dyeing cloth. The Arabs call it Bahr Soof. It is long and narrow, and divided by the Peninsula of Sinai at the upper end into the Gulf of Suez and the Gulf of Akabah. Its navigation has at all times been considered difficult and dangerous, and although steam and lighthouses have contributed to lessen the danger, its passage calls for watchful care. It is almost impossible for a sailing vessel to reach Suez between May and November. The temperature is high, but the heat is more of a bugbear than is usually supposed unless one is obliged to go down the sea in Summer, in which case he must expect to suffer. On the eastern side are Mocha and Djiddah, (the port of Mecca) where arrive hordes of pilgrims on their way to the tomb of the Prophet.

In thus voyaging near those lands in which tradition places the cradle of our race, it certainly seems somewhat of a misnomer to speak of *Modern* Ocean Highways. Granted, that Lieutenant Waghorn, who projected this modern Red Sea route to India, has not been very long dead; granted, too, that Mr. De Lesseps dug the Suez Canal,—but what says the Royal Preacher?—"The thing that hath been, it is that which shall be, and that which is done, is that which shall be done, and there is no new thing under the sun."

If there is one word in particular which we commonly use without an adequate conception of its meaning, it is "antiquity," and we ought to visit these regions to improve our comprehension thereof. Not far from the head of this sea stands that one Great Pyramid which Professor Piazzi Smith says was built by a race of Hyksos, or Shepherd Kings, to which belonged Melchisedec. Across the Gulf of Suez, according to tradition, went the children of Israel. There is a record of the navigation of this Red Sea some three thousand two hundred years before the day of Lieutenant Waghorn, and triremes went through a Suez canal two thousand five hundred years before Mr. De Lesseps was born. Hebrew and Phœnician ships sailed down this sea, on their way to Ophir, in the fourteenth century before Christ. Eastern merchandise passed up it, on the

way to Venice, twenty-eight hundred years later. Then the route around the Cape was opened, and travel left the Red Sea. But now the Canal of Neco, the son of Psammetichus, which ran from the Nile, near Bubastis—closed for long centuries—lives over again in the fresh water branch of Mr. De Lesseps' great work, and the four thousand-ton steamer has replaced the triremes. Its old glory is more than restored to the Red Sea, after ages of patient waiting, "That which hath been is now, and that which is to be hath already been."

In about six days after leaving Aden, we see the scorched mountains on the African side, and the Sinai range on the east. The peak commonly accepted as Sinai itself cannot be seen from the steamer, but voyagers, particularly those outward bound, insist on seeing it. As a shorter way of disposing of the question than argument, a convenient mountain has been selected and is shown. It is happily known as the "Passengers' Mount Sinai." Then comes into view the *olla podrida* of foreign buildings and squalid native huts, which make up Suez, known earliest in history as Arsinoe. Its associations are interesting, but a short sight of it will make you take them all for granted; and we enter the mouth of the canal, which is to the east of the town. Many of you may know that the regular salt water canal, some ninety miles in length, is cut from sea to sea, passing through the Bitter Lakes and Lake Menzaleh en route; while the smaller, or fresh water canal, runs from the Nile to Suez. The canal varies in width, being sometimes hardly more than broad enough for the steamer, and it is provided with turn-outs. Vessels have to take an experienced canal pilot and run only by day, and at about five kilometres per hour. If you start early in the morning, you are likely to pass the night in sight of Port Said, and to have an opportunity of going ashore and inspecting the desert in that wonderfully cool, exhilarating, evening air. Ismailia, where the Khedive has a palace, and Mr. De Lesseps a cottage, is passed about midway, and then comes Port Said, a place as emphatically the product of the canal, as the canvas and rough board settlements of the plains are those of the railroad. It need not detain us long, but we must admire the fine harbor, made by building a concrete breakwater at the west of about a mile in length, and one at the east of about half a mile. Here is the second best light in the European seas, excelled only by that at Havre. Some of my views will help me give you a correct idea of the canal, and as my set ends at Port Said, I will now show them to you, and then ask of your patience the time for a few remarks in concluding my lecture.

List of Views.

Leaving Port Said, we traverse the blue waters of the Mediterranean, are on the track of the Apostle Paul, perhaps encounter the same "stormy wind called Euroclydon" which troubled him, pass at length through the beautiful Straits of Messina, and stop at Naples; or we take our chances of the "mistral" in the Gulf of Lyons and go to Marseilles. We can also leave the steamer at Ismailia, and go to Cairo and Alexandria, and then to all parts of the Mediterranean. The P. and O. steamers go to Brindisi and Venice, Malta, Gibraltar, and Southampton ; the Austrian Lloyd's to Trieste. To London and Liverpool the journey is simple and easy, and then we have to sail for New York.

In speaking of ocean highways we must, as the saying goes, "draw the line somewhere," and I propose to draw it east of the "ocean ferry."

It is remarkable that our people of all ranks and classes, young and old, great and small, "the old man and the infant of days," look forward eagerly to, enjoy in itself, and remember with delight, the voyage to Europe, while if you propose to them to go to the

East, they take *omne ignotum pro terribile,* conjure up visions of danger, and respectfully decline. I remember a young New Yorker sitting, in the flush of health and strength, in a luxurious dining-room at Shanghae, smoking a fine cigar; who had just come from the commodious steamer in which his voyage had been safe and prosperous, and was waiting for a brougham to take him out to a particularly good dinner; and who told me that his friends at home had done all in their power to dissuade him from encountering the *hardships of a visit to China.* Permit me, as a comment on such sentiment, to tell you, on the faith of an old traveler, that of all the long journey around the globe, from the time that you lose sight of the spire of old Trinity until it again comes in view, the portion the most uncomfortable, the most patience-trying, the most dangerous, is that between Liverpool and New York.

I have spoken of existing ocean highways, and must very briefly allude to projected ones. Regarding the canal at the Isthmus of Darien or Nicaragua, I think of but one thing omitted to be said when Admiral Ammen described it so well in this hall, and that is that while the Suez Canal is useless for sailing vessels, this will give them a ready passage. What a revolution it will make you can easily conceive. Then, do you remember the North-west Passage, in searching for which that great captain, Sir John Franklin—on whose tablet in Westminster Abbey we read: "Oh ye Frost and Cold, oh ye Ice and Snow, bless ye the Lord!"—lost his life? And have you heard, too, of the North-east Passage, to search for which the brave Nordenskjold has gone? From the days of Hendrik Hudson until now men have not been wanting, nor will they be in the future, willing and eager to attempt to penetrate into the desolate Arctic Ocean:

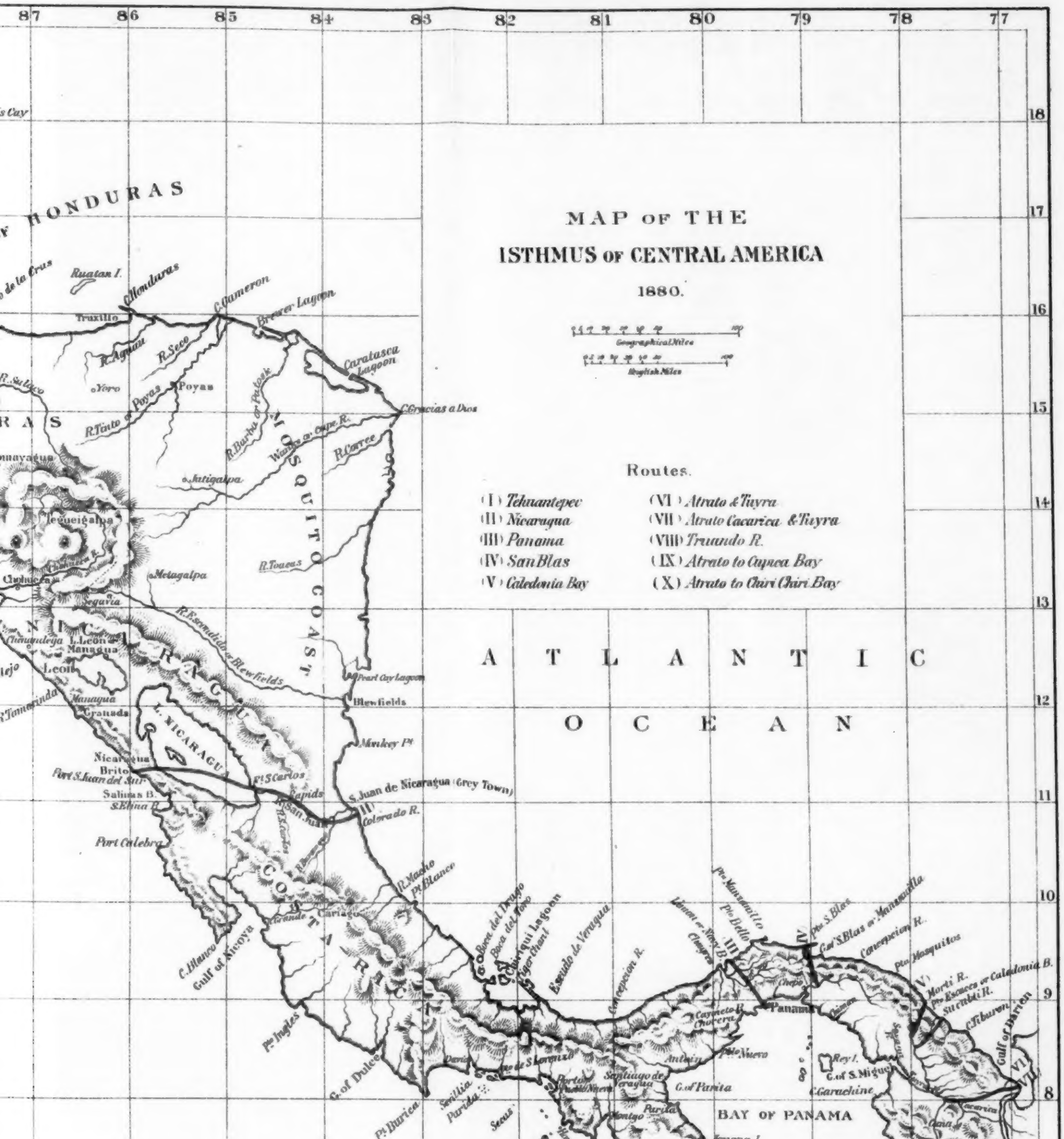
"A weird and awful sea, its surges roll
In solitude, and unexplored expand
From age to age around the Arctic Pole,
And beat with hollow roar a frozen land,
Whose adamantine crags behold no sail
Reel on that howling ocean to the northern gale."

Did you ever read of the aged Humboldt lying, in the last days of his life, in his darkened room, and seeing pass before his closed eyes delightful visions of the scenes of his former wanderings; the majestic Amazon, the tall peaks of the Western World, the luxuriant verdure and gorgeous sunsets of the Eastern tropics? So, permit me to say to you, in conclusion, there is no way of which I know whereby you can, given certain conditions, find more present pleasure, or lay up richer store of enjoyable retrospect, than by a personal inspection of

MODERN OCEAN HIGHWAYS.

AMERICAN GEOGRAPHICAL SOCIETY

JULIUS BIEN LITH. N.Y.


MAP OF THE
ISTHMUS OF CENTRAL AMERICA
1880.
Geographical Miles
English Miles
Routes.
(I) Tehuantepec
(II) Nicaragua
(III) Panama
(IV) San Blas
(V) Caledonia Bay
(VI) Atrato & Tuyra
(VII) Atrato Cacarica & Tuyra
(VIII) Truando R.
(IX) Atrato to Cupica Bay
(X) Atrato to Chiri Chiri Bay
ATLANTIC
OCEAN
HONDURAS
MOSQUITO COAST
NICARAGUA
COSTA RICA
BAY OF PANAMA
Ruatan I.
C. Honduras
Truxillo
C. Cameron
Brewer Lagoon
Caratasca Lagoon
C. Gracias a Dios
R. Aguan
R. Seco
Yoro
Poyas
R. Tinto
R. Carree
Jutigalpa
Tegucigalpa
Metagalpa
R. Toacas
Segovia
Managua
Leon
Granada
L. Nicaragua
Pearl Cay Lagoon
Blewfields
Monkey Pt.
Nicaragua
Brito
Port S. Juan del Sur
Salinas B.
S. Elena B.
Port Calebra
Rapids
S. Juan de Nicaragua (Grey Town)
Colorado R.
Pt. Blanco
Cartago
Gulf of Nicoya
C. Blanco
Pta. Ingles
G. of Dulce
Pt. Burica
Chiriqui Lagoon
Escudo de Veragua
Concepcion R.
Pta. Manzanillo
Panama
Chepo
G. of S. Blas
Concepcion R.
Pta. Mosquitos
Gulf of Darien
C. Tiburon
Santiago de Veragua
G. of Parita
Parita
Rey I.
G. of S. Miguel
C. Garachine
Iguana I.
C. Mata
Morro de Puercos
Quibo
Cebaco
Pta. de Mariato
Kelly's Inlet
Pta. Marzo
Cupica Bay
Chiri Chiri Bay
Quibdo
Longitude West from Greenwich
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THE INTEROCEANIC SHIP CANAL.

MEETING AT CHICKERING HALL.

December 9, 1879.

PAPER BY REAR-ADMIRAL DANIEL AMMEN, U. S. NAVY,

Representative of the United States in the Congress at Paris on

THE PROPOSED INTEROCEANIC CANAL ACROSS NICARAGUA.

Addresses by CHIEF-JUSTICE DALY, and A. G. MENOCAL, Chief-Engineer, U. S. Navy.

Letters from FREDERIC M. KELLEY, WALTON W. EVANS, C. E., and NATHAN APPLETON.

Report on the Proceedings of the Congress in Paris, in May, by Rear-Admiral DANIEL AMMEN, U. S. Navy (See Appendix A).

Views of WALTON W. EVANS on the proposed Canal between North and South America, dated May 9, 1879, and addressed to M. C. AUGUSTE VON HERNERT, for submission to the Paris Congress.

Report of W. E. JOHNSTON, M. D., Delegate of this Society to the Paris Congress, dated August 15, 1879, on the Proceedings of the Congress.

THE NICARAGUA CANAL: Extract from Mr. S. B. RUGGLES's Semi-Centennial Address at New Haven, July 27, 1864.

Among the prominent gentlemen upon the stage were Chief-Justice Daly, A. G. Menocal, C. E., Signor de Franco, General George W. Cullum, U. S. A., Francis A. Stout, William Remsen, Harlow M. Hoyt, William H. Webb, William H. H. Moore, General Egbert L. Viele, Colonel T. Bailey Myers, James T. Gardner, Director of the New York State Survey, Elial F. Hall, John E. Body, and Sidney F. Shelbourne.

The formal business of the evening having been disposed of, the President introduced Colonel T. Bailey Myers, of the Council, who, at the request of Admiral Ammen, read his paper—the principal topic of the evening.

THE PROPOSED INTEROCEANIC SHIP CANAL ACROSS NICARAGUA.

BY

REAR-ADMIRAL DANIEL AMMEN, U. S. NAVY.

[In the absence of the author, this paper was read by Colonel T. Bailey Myers, who briefly referred to the topic as follows :]

Ladies and Gentlemen—In fulfilling a duty devolved upon me by Admiral Ammen, I regret that he could not have been here in

person. An accidental association some years since as members of the Board of Visitors at the Naval Academy, ripening into friendly relations and correspondence, probably induced him to select me to represent him. With no personal interest in the enterprise, I have the highest opinion of his capacity and the value of his opinion. His paper was forwarded before the opening meeting, but was deferred to that of Lord Dunraven, who was in haste to leave the country. It seems proper to make an explanation on behalf of the Council of the position of the Society on the Interoceanic Canal question. Its Hall and Journal have been open for years for its discussion. Foreseeing that all attainable information on the subject would soon be necessary, a committee of the Council, consisting of Mr. Clarence King (Director of the United States Surveys), Mr. Francis A. Stout (Commissioner for the New York State Survey), and myself, by memorial and personal attendance at Washington, urged Congress, last winter, to print the surveys and statistics connected with the Government work on the Panama and Atrato-Napipi routes executed long before. This was only completed in a temporary form in time for the use of the Congress at Paris, and has recently been officially published. Access to it could not be had by the Society before that time, and was refused to individuals. In sending representatives to that Congress, the Society, therefore, claimed to take no part in the decision of an important question, of the merits of which, for these reasons, they could be but partially informed, but only as an appreciation of its importance, and to acquire information. Naturally they could not express an opinion without the time for study of prior details, nor could they expect that their representatives, during its brief and exciting session, should become able to do so. Two of these representatives have since given to the public their conflicting views on the plan presented by M. de Lesseps—Dr. William E. Johnston, residing in Paris, by his able written report to our President, Chief-Justice Daly, received in the vacation, and Mr. Nathan Appleton, in reading at about the same time a paper before the Board of Trade, supplemented by a communication to be read this evening.

Admiral Ammen, as Chief of the Bureau of Navigation, having been charged with the fitting out of the American explorations, and as a member of a commission formed by the Government for the consideration of its plans, having studied their results, has labored under

no such difficulties. Those who know his capacity and devotion to every duty will believe his to be of the greatest value as an educated opinion. Knowing that other conclusions will be advanced, he has authorized me to say that he is prepared to sustain it, and to reply to them if brought to his attention in the public press, that he considers the subject worthy of exhaustive, if competent, discussion.

Of one so important, those present will, it is hoped, patiently submit to an extended discussion, caused by a desire to entertain all opinions, and open its merits to a free investigation. I will now read Admiral Ammen's paper.

THE PAPER.

I am indebted to a prominent member of your Society for the suggestion that I should continue the discussion of the Interoceanic Canal question under its auspices.

I propose for your examination, "The Present Aspect of the American Interoceanic Canal Question."

I shall not tire the patience of my hearers by an attempted history of this subject; those who are desirous to inform themselves as to what was known and what was asserted prior to 1866, can do so by reading a Report to Congress by Rear-Admiral Davis, U.S.N., published that year under the title of "Interoceanic Railroads and Canals," of course referring to this continent. It contains from pages 31 to 37 the authorities cited; a large amount of valuable information necessarily interspersed with much that is wholly unreliable, or only of partial value. The elimination of mere assertions and of errors has added vastly to the work of exploration and survey since that time. For an outline as to what has been done since then, I may refer you to my paper of Oct. 31, 1876, and a second, read Nov. 15th, 1878, before your Society.

The first paper was intended to show the errors of M. Drouilet, French engineer, and those who regarded him as an authority, as shown in a pamphlet issued in Paris in May, 1876, apparently with the approval of the commercial branch of their Geographical Society. It was designed to show that there did not exist unknown routes comparable for the construction of a ship canal to those already known. The second paper was to show the feasibility of a ship canal via Nicaragua as a commercial question, and to do this it

seemed to me necessary to establish its superiority over all known points, especially as to economy of construction and permanency of works, from less liability to the destructive effects of floods or other probable causes.

In the month of March last, when our Government thought proper to have our maps and plans, the results of close instrumental surveys on the Isthmus of Panama, and also those known as the Atrato-Napipi route, published for presentation to the Congress called to assemble at Paris on the 15th of May, it was considered desirable that I should go abroad to present them, with such other surveys as had been recently made under its orders.

I suggested that I had been one of a Commission appointed by the President on the 13th of March, 1872, for the purpose of examining into and reporting upon the question of a ship canal across the Continent, and that on the 7th of February, 1876, this commission had made its report as to locality, etc., which had been acceptable to the Government. It seemed to me, therefore, that some other person should be selected to attend the Congress. A second objection was that the selection of the canal route was eminently a question capable of settlement only by the ablest engineers, and those of the highest character. I urged further, that Commander E. P. Lull, of our Navy, who had been engaged on the surveys of Caledonia bay, and south of it, and afterwards had been chief of the parties making the surveys of the Nicaragua and the Panama routes, could well take my place, as he had a rare judgment and capacity, which would enable him to present fairly such work as he had done in comparison with the surveys made under the direction of other officers.

Notwithstanding these representations made by me, I found that the Government preferred my going as a delegate, when of course I appreciated fully the honor, and made such suggestions as seemed necessary to discharge properly the duties which belonged to the position. It seemed to me important that the civil engineer who had been employed on both the Nicaragua and Panama surveys, and who had performed his duties most satisfactorily to the officer conducting them, should go also, either as my assistant or as a delegate, to make the technical development of the routes. The suggestion was carried out, and I may add that, so far as I am aware, Civil Engineer Menocal performed his duties with entire satisfaction to our Government. In presenting important informa-

tion to the Congress, the results of our Government surveys, it seemed necessary that certain ideas connected therewith should be expressed. For that reason, what I shall hereafter call my "Address" to the Congress was prepared, and submitted to the inspection of the department of our Government under whose instructions I went abroad. On arriving in Paris, the day preceding the meeting of the Congress, Mr. Menocal and myself lost no time in paying our respects to M. Ferdinand de Lesseps, too widely and too favorably known to require further comment, unless I may add that then and on all other occasions our intercourse was in all respects agreeable.

On the morning of May 15, preceding the meeting of the Congress, I received a visit from M. Blanchet, an agreeable French gentleman who had been to Nicaragua on two occasions to secure a concession for the construction of a ship-canal, and indeed had one, which last March was rejected by their Senate. I was informed by him that the previous evening M. de Lesseps had either caused a meeting to be held or an agreement entered into that was acceptable to M. Blanchet, and to the party in the Congress who would support the Panama project. My understanding of this was that they had agreed to permit the discussion of the question to stand on its merits, and that which ever side lost the vantage ground, would receive some recompense which had been agreed upon in advance. Once at least during the sitting of the Congress I received a visit from M. Blanchet, who seemed to be very much excited about the question, and to think I should be also. I told him that the decision of the Congress was no concern of mine; that my duties would be discharged by making a fair and full presentation of all the information in the possession of our Government, which was in fact the object of my being in Paris. After the adjournment of the Congress, previous to my leaving, I received another visit from M. Blanchet, who informed me, or at least conveyed the impression, that his opponents had acted in bad faith with him.

On the meeting of the Congress on May 15, an immediate organization was effected, M. de Lesseps being chosen President, with five Vice-Presidents.

The names of the members of the different Commissions were called, as follows: 1st, Statistics; 2d, Economic and Commercial; 3d, Navigation; 4th, Technical; 5th, Ways and Means.

After naming the members of the Commissions M. de Lesseps remarked in a jocular manner that our work was all cut out, that many of the delegates were anxious to get home, and that we could carry the work through *à l'Américaine*, which may be translated *with a rush.* The full meeting of the Congress was then adjourned until the 19th; the Commissions met at 9 o'clock the following morning.

Owing to the non-arrival of our heavy package of books, maps, etc., I was not able to present them the next day, as desired, but did so on the morning of the 17th to the Technical Commission. On their presentation I stated that I would have my remarks printed in French and English. The following day copies were in the hands of the Secretary for distribution to such persons as wished them. The address was as follows:

Gentlemen : The Government of the United States has conferred upon me the honor of presenting for the consideration of this learned and distinguished body several surveys, recently executed by its order, a part of them published only within the past month In their order from the North to the South, they are as follows :—

1. The survey of the Isthmus of Tehuantepec, by R. T. Shufeldt, now Commodore U. S. Navy.

2. The survey of what is known as the Nicaragua route, an actual location of an interoceanic ship canal, with several tentative lines, by Commander E. P. Lull, U. S. Navy, assisted by Civil Engineer A. G. Menocal, U. S. Navy.

3. The survey of what is known as the Panama route, an actual location of an interoceanic ship canal between Aspinwall and Panama, including feeder, etc.

4. The report of the surveys made by Commander T. O. Selfridge, U. S. Navy, extending from the Gulf of San Blas on the Atlantic and the Bayano or Chepo river on the Pacific coast to the mouth of the River Atrato on the Atlantic, to the Gulf of San Miguel on the Pacific coast, involving many tentative lines, and thence following up the River Atrato 150 miles, and from thence up the valley of the River Napipi, known as the Atrato-Napipi route, and terminating on the Pacific coast at Chiri-chiri.

5. An actual line of location for an interoceanic ship canal, of what is known as the Atrato-Napipi route, terminating as before at Chiri-chiri, by Lieut. Frederick Collins, U. S. Navy.

Maps, plans and calculations for material and labor on a common basis of cost are made for the "Nicaragua," "Panama," and "Atrato-Napipi" routes, as located, affording a ready means of finally considering the relative cost of executing the work on the several routes.

On the 13th of March, 1872, the President of the United States appointed a commission whose duties were "to examine and consider all surveys, plans, proposals or suggestions of routes of communication by canal or water communication between the Atlantic and Pacific oceans, across, over or near the Isthmus connecting North and South America, which have already been submitted or which may hereafter be submitted to the President of the United States during the pendency of this appointment, or which may be referred to them by the President of the United States, and to report in writing their conclusions and the result of such examination to the President of the United States, with their opinion as to the possible cost and practicability of each route or plan, and such other matter in connection therewith as they may think proper and pertinent."

A final report was made by this commission on the 7th of February, 1876, copies of which are furnished for the consideration of this Congress. It was composed of the Chief of Bureau of Engineers, U. S. Army, the Superintendent of the U. S. Coast Survey, and the Chief of Bureau of Navigation, U. S. Navy. It held its sittings at various times and considered all of the information then existing, and concluded that the various surveys and reconnoissances extending over the wide region involved were sufficient to arrive at a conclusion, except in the region lying in the vicinity of the Panama railroad ; it therefore requested the Government to have a survey made and an actual line of location for an interoceanic ship canal on the best route found practicable in that region, which was done without delay. The Government, at the same time, thought it advisable to have a more thorough examination and actual location made along the entire length of what is known as the Atratro-Napipi route. After a careful study of these surveys, maps, plans and estimates, in addition to the information which was previously before it, the commission made its final report, before alluded to.

In the consideration of a great work, such as the construction of a ship canal across the American continent, we may well suppose that its permanency should be regarded as important as the selection

of the route itself, involving the least cost of construction with the minimum of problems of doubtful cost in the execution of the work. With these points assured the question becomes fairly debatable, whether the physical conditions are to be considered too formidable to admit of the execution of the work, as a commercial or monetary question—in fact, whether a grand idea for the amelioration of the great commerce of the world can be put into execution, or, perforce, must be abandoned, through the existence of obstacles too formidable in their nature to admit of an endeavor to overcome them.

Should it be considered, after a careful and minute examination of the question, that a commercial or monetary success is practicable in the construction of an interoceanic ship canal, whatever error may obtain by the selection of an inferior route through a misapprehension of conditions of permanency, or of first cost of construction in the location of the ship canal, would work a double injury, in the failure to yield a proper dividend, by reason of unexpected and extraordinary cost in construction, through constant demands for heavy expenditures in the endeavor to keep the canal navigable, and in the probable imposition of tolls, which would tend to drive away or fail to secure a considerable part of the tonnage which should naturally pass through it. This would make the ship canal appear rather as an obstructor than the promoter of a world-wide commerce. I feel sure that these considerations will have weight in the mind of our distinguished President, at whose call this assemblage has met, to whose genius and indomitable energy are due the inception and the completion of the Suez Canal.

I shall leave to my able associate, Civil Engineer A. G. Menocal, U. S. Navy, a minute presentation of the surveys upon which he was engaged—namely, what are known respectively as the "Nicaragua" and the "Panama" routes. His note-books and other data will show that the plans and estimates are based upon substantial and sufficient information.

There are certain comparative conditions affecting the execution of the work on the three different lines, upon which we give maps, plans and estimates, which it is important to bear in mind in the consideration of the subject of the construction of a ship canal.

In respect to the Nicaragua route, it may be said that the rainfall is comparatively small. Our observations at Lake Nicaragua, extending over one year, show an annual rainfall of 48

inches, or 1.22 metres.* There is a distinct dry season of between five and six months, when work in progress would not be delayed or injured, and but little interruption need be apprehended in the rainy season on that portion of the canal between the lake and the Pacific, as the rains generally fall at night, with occasional showers during the day.

There is abundant good stone, hydraulic and other lime, wood and bamboo, which latter may be found very advantageous in the construction of harbors.

There is a considerable population, well disposed, and when they can have remunerative employment, fairly industrious. The country has an abundant cattle supply of good quality for food, and other productions which would furnish the main subsistence for laborers on the canal, with a convenient water transportation in general along the line of ship canal as located, and lake communication with an extensive, populated and fertile region. This water communication can be greatly increased by the construction of a six-foot canal to Lake Managua, at an inconsiderable cost, and when completed it would make the supplies of all kinds superabundant. Between Lake Nicaragua and the Pacific, near the line of the projected canal, several passable roads exist, and whatever other roads might be required over this short distance could readily be made at inconsiderable cost.

There is an inexhaustible water supply in the lake of 2,800 miles of superfice, which equalizes floods and makes the daily changes small in the discharge of the River San Juan, by which it debouches into the Caribbean sea.

It has an excellent harbor on the Pacific coast at San Juan del Sur, convenient for anchorage as Brito itself would be if improved as a harbor, inasmuch as the vessel in transit would have time to regulate her steam and be pointed fair to enter the canal at any assigned time. This reduces the necessity of a harbor at Brito to simply securing a perfectly smooth entrance to the canal.

Lake Nicaragua affords every facility for an interchange of cargoes that may be desired.

The western coast and valley of the lake are, as compared with

* Observations since collated, extending over 1851, by Childs, and 8 months by Lull, 1873, give a mean 82.65 inches.

the eastern slope, comparatively healthy, and upon the eastern slope a considerable part of the labor can be done by means of dredging machines.

The approaches to both entrances are superior in advantages to those of either of the two other routes with which the Nicaraguan is compared.

These considerations would seem to warrant the belief that cost of construction, including material, would be far less than upon either of the two other routes compared, as will be more fully shown hereafter.

The Panama route is next to be considered.

The mean annual rainfall at Aspinwall in a series of seven years is found to be 124.25 inches, or 3.15 metres. A dry season exists, but it is limited to two or three months, lessening the effective time for labor and of comparative healthfulness of the laborers employed, the wet being the sickly season.

No building material suitable is known in that region. The ties and railroad telegraph poles on the Panama railroad are brought from Carthagena or elsewhere.

The population is inferior to Nicaragua, as, also, the country, in ability to furnish subsistence for a large number of laborers.

By means of the railroad already constructed, a canal under construction would have a convenient transportation at whatever cost might be agreed upon.

The cost of the feeder and adjuncts, and other disadvantageous features (notwithstanding the shortness of the line), as shown by maps, plans, and estimates, make a total of $94,511,360, against that of the Nicaragua route of $65,722,137 *on a common basis of cost of material and labor.* In Nicaragua the material is near at hand, and subsistence abundant, while on the Panama route, or in its region, there is no material for construction, inferior subsistence and less favorable climatic conditions for labor, as before stated.

The last proposition which remains to be examined is in favor of the Atrato-Napipi route.

Although the mean annual rainfall here is not known, there is no doubt that it is largely in excess of the rainfall at Aspinwall. There is only a nominal dry season, as at any time a precipitation of several inches is likely to occur, and actually does occur many times yearly during the so-called "dry season."

The building material supposed to be available is confined to wood. Population is so scant as to be unable to furnish either assistance or subsistence for even an inconsiderable number of laborers.

The River Atrato would furnish transportation to the mouth of the River Napipi. Along the line of the projected canal the country is alternately rough and covered with swamps, so that great labor would be necessary to construct roads to secure even wagon transportation for subsistence and material for construction.

Under such conditions the projected feeders requisite would be made at great additional cost, as well as the projected tunnel and locks. In dimensions the projected tunnel is as follows: length, 5,633 metres ; height, 35.96 metres ; width, 18.29 metres.

On the Atlantic slope there are twelve projected locks of 3.14 metres lift, and on the Pacific slope ten of 4.54 metres lift, the summit level being 43.59 metres above mean tide.

With the view of having a definite comparison, the estimates for material and labor, so far as they are identical, were made on a common basis with Nicaragua. The cost on this basis is given as $98,196,894 ; but it is quite apparent that with the lack of material convenient, and of subsistence and transportation, as well as the absence of a dry season, and above all, the impossibility of making even an approximate estimate of the cost of a tunnel under such conditions, that the actual cost of the execution of the work would be far in excess of the estimate.

The same physical conditions—the absence of a dry season, and a general lack of material for construction, except wood, and the lack of subsistence—were found to exist by all of our parties, at various times, on what is known properly as the Isthmus of Darien, and of all the region lying south of it.

The long period of time over which the surveys of the United States have been prosecuted, designing to elucidate the problem of an interoceanic ship canal, indicates a persistent interest in this subject. I am happy to add that the present chief magistrate and his cabinet are fully alive to the benefit to be derived from a full consideration of the construction of an interoceanic ship canal, now that further researches of the topography of that region no longer promise a commensurate reward.

The people of the United States will look with great interest upon the discussions and deliberations of this distinguished convo-

cation, and to suggestions which indicate the means that may be adopted to secure a speedy commencement of the work of an American interoceanic ship canal on such a basis as should assure its uninterrupted prosecution and early completion. It would seem that this object could best be accomplished by making the work actually International, could a proper and satisfactory basis of coöperation be arrived at.

The people of the United States recognize the great amelioration and benefit that the commerce of the world would derive through the completion of this great work, and are not disposed to regard the consideration of this subject solely with reference to the degree in which the commerce and the interests of the United States will be relatively benefited through its construction, as compared with the advantages that may accrue to other commercial nations. Such a ship canal cannot fail to be a great and common benefit, especially in opening a rapid and easy transit between the Atlantic coasts of Europe and America and the western coasts of America, and by the speedy development of Australia. Regarding this interoceanic ship canal when completed as the greatest possible artificial highway that can be constructed, conferring benefits on all nations and peoples, the people of the United States consider its construction as something of common interest, and the guaranty of its neutrality a duty in common to all nations.

The presentation of maps, plans, etc., was followed by a technical exposition of the Nicaragua route by Civil Engineer Menocal. Afterwards, in answer to inquiries, he gave the methods of proposed improvement of the harbor of Greytown and the regimen of the bar, as observed by him during several recent visits to that locality. I may add here properly, that the able sub-commission subscribed to the efficiency of the proposed method, and as well to the method proposed for constructing the dams across the San Juan. Several engineers of note at that time not favorably disposed to the Nicaragua route, made many inquiries, with the view of developing its difficulties and its inferiority, and became so well informed as to adopt it as the route offering relatively the fewest difficulties, and in the end *certainty of execution.* These engineers were found afterwards among those who abstained from voting.

On the second general meeting of the Congress, May 19, Sir John Hawkshaw, of England, whose reputation as an hydraulic engineer is second to none, was present. The afternoon was taken up in a desultory discussion of the Panama route by Lieuts. Wyse and Reclus, of the French Navy. A considerable part of the discourse was directed to the Nicaragua route, *which was not then under discussion.*

The data upon which these plans were constructed was quite insufficient. The cause of the anxiety of Lieut. Wyse, when in the United States two months before, to obtain tracings of our maps and plans, became at once apparent. They were not furnished, because it was considered improper to give them publicity abroad in advance of their publication at home.

It will be remembered that previous to last autumn, after making an examination of the valleys of the streams falling into the Bay of San Miguel in 1876–7, and visiting that region the following season, Lieut. Wyse made plans and estimates for two routes, calling the one preferred by him the Tuyra-Tupisa route, which by his report was supposed equal, or nearly so, to any that had been developed through our surveys. This line seemed to me hopeless, from the existence of the gravest difficulties, some of which I mentioned in my paper of November last. It seems, from what I shall presently quote, that Lieut. Wyse had the frankness to inform the Society for which he was acting that in his view a ship canal across that region was impossible. He did not present it at all in the Congress, but took up the Panama route on whatever information he had, and developed it for a ship canal *à niveau*, which certainly was a step in the right direction. It may be said without dispute, that for a canal at the ocean level the line from Panama to Aspinwall is far preferable to any other. The *possibility* of it must be considered simply in a commercial sense, as a canal, wherever made, must have that condition. The following day, May 20, Civil Engineer Menocal was invited to explain the plans and estimates of the Panama route, but was so interrupted by questions that Sir John Hawkshaw suggested allowing him to proceed, and submitting questions afterward.

He stated that when Commander Lull and party began the survey of the Panama route there was no pre-occupation as to what height above the sea, if any, would be selected as the summit level. They

found at Matachin that the floods of the river passed some five or six feet over the railroad track, and that at low water the surface of the stream was forty-two feet above the ocean level. In considering the question it became apparent that if the ocean level were adopted, an excavation would be necessary, making the normal surface of the proposed canal forty-two feet below the present low water, in the river, which would then make a small cascade, and in periods of floods would be transformed into a cataract of one hundred and sixty-one thousand cubic feet per second, of a height of nearly seventy-eight feet, the decrease being due to the measure of the velocity of the water as it approached the precipice, and also to the head of water above the ocean level after falling, which would give a corresponding velocity on its course to the sea. It was apparent that either this great volume of water must be received into the canal from an elevation which would make the effect destructive, or that it would be necessary to "lock up" so as to permit the floods to pass beneath the aqueduct, thus bringing the surface level of the water in it to an elevation of one hundred and twenty-four feet above the sea. This was found to entail the construction of a feeder, with its adjuncts, at a cost of $9,942,727, with either a doubtful or a scant water supply during a portion of the seasons of unusual drought.

On concluding, Mr. Menocal stated his willingness to answer questions, without eliciting any more.

On the 21st another general session was held. Sir John Hawkshaw gave his opinion on the Panama route as follows:

"With regard to the question whether the canal should be constructed with or without locks, the following points occur to me:

"If the canal is to be without locks its normal surface level would be that of the sea, and its bottom level, say eight meters lower.

"This being the case, the canal would receive and must provide for the whole drainage of the district it traversed.

"Therefore it would be necessary to ascertain the volume of water that would drain into the canal before it would be possible even to determine the sectional area of the canal.

"If the canal have a less surface fall than the river, as it would have, it must have a larger sectional area to discharge the same volume of water.

"The average section of the river in a flood at Mameï was ascertained by M. Reclus to be 1,310 square metres. This would require a canal, if it were eight metres deep, to be 160 metres wide.

"The waters of the Chagres would have a tendency to flow towards the Pacific, that is, through the tunnel, as the distance is less and the fall greater than to the Atlantic.

"It seems to me that the dimensions of the tunnel, if it has to serve for both the river and canal, would be too small. Mr. Menocal's estimate of the volume of the Chagres in time of flood would much more than fill the tunnel; and in any case the whole section of the tunnel is only half that of the river in time of flood, as given by M. Reclus.

"During the construction of a canal at the sea level, difficulties would arise in providing for the drainage, which would affect both time of execution and cost to an extent that could hardly be ascertained in advance.

"If, from such considerations as the foregoing, it should be concluded that the canal should be so constructed as to retain the rivers for natural drainage, then recourse will have to be had to locks. In that event there can be no difficulty, in my opinion, in carrying on the traffic with locks properly constructed, provided there is an ample water supply, which would be a *sine qua non.*"

It will be observed that Sir John Hawkshaw expressed the axioms heretofore acknowledged by able engineers : to avoid surface drainage, and to have an abundant water supply. After reading his opinion, he remarked that a residence of two or more years in Intertropical America had given him a knowledge of how these showers behave, without which he might think differently. In a conversation with him before he left Paris, after two days' attendance at the Congress, he expressed to me the opinion that the canal could not be excavated *à niveau*, and if it were that it would be filled up with trees and silt.

A pamphlet by M. Dauzats, Chief Engineer of the Suez canal, compares that work with the various routes proposed across this continent. He quotes at length from my last paper read before this Society showing the marked contrast of physical conditions, the region of the Suez canal having a mean annual rainfall of less than two inches, whilst the region of the Panama canal has a rainfall of one hundred and twenty-four inches. His deduction is that surface

drainage falling into a canal, has a scouring effect which is beneficial, whilst the abrasion of the banks of a canal is far more destructive.

Were it not too great a tax on your patience, I would point out the fallacy of such an argument. It is assumed that when a river like the Chagres is dredged, it will change its regimen. This deduction is necessary to a supposition that a canal *à niveau* at Panama is possible.

On the afternoon of the 19th, the Technical Commission was divided, one part to report upon the practicability of locks as presented on the Nicaragua route, the other to consider the question of making tunnels for navigation. There was confusion and violent action, I was informed, on the part of Lieut. Wyse, growing out of his opposition to Mr. Menocal being put on the sub-commission on locks. Mr. Menocal very properly asked to be excused.

The report as to locks was, that they could be made to serve their purpose. The calculations for a tunnel were made for construction on a dry foundation ; it was stated there were no elements of calculation for building a tunnel below the sea level, as the plans demanded.

During the sittings of the Congress, I found myself frequently obliged to dissent from the propositions of Commander Selfridge, U. S. Navy, who strangely enough was found in the Congress without being named by our Government. This officer had been the chief of large parties who were engaged during the seasons of 1870, 1871 and 1873, in examining the coast lying south and east of the Panama route, at San Blas, Caledonia bay, the streams flowing from the flanks of the mountains adjacent to the Bay of San Miguel and of the counter slopes falling into the Atlantic ; also in making an examination of the Atrato-Napipi route for a ship canal, which will be found in his report to the Secretary of the Navy, June 12, 1873.

I refer the curious reader to pages 66 to 70 inclusive and to map VIII, illustrative of the Atrato-Napipi route as developed by Commander Selfridge. Nobody reading this report and referring to the drawings would suppose for an instant that the greater part of it was purely imaginary, the ground lying between the rivers Atratro and Doguado never having been passed over by Commander Selfridge or any of his party. It is delineated as an inclined

plane, locks located and sections of elevations given in figures ! Between this fanciful presentation and the profiles made by Lieut. Collins, U. S. Navy, there is a very wide difference. I quote from page 7 of my report :

"Commander Selfridge then said that the remarks made by Sir John Hawkshaw in relation to the Chagres River were not applicable to the Atrato-Napipi route, and endeavored to enter into a further discussion of its merits. I stated that I would suggest the advantage of discussing the carefully prepared plans of Lieut. Collins along the lines of actual location, which were the best that could be found in months of labor, instead of lines drawn at will by Commander Selfridge, involving uncertainty of execution and an entire absence of elements of calculation, as every engineer wonld recognize."

This was one of several occasions that I had to suggest the advantage of discussing facts instead of indulging in fancies calculated to deceive the credulous and unwary, and absolutely a waste of time.

The proceedings of the general Congress on the 23rd, and in the Technical Commission on the 26th, are so significant that I shall append them without omissions.

By reference to the Appendix it will be seen that the partial quotations which I shall use do not present a perverted meaning. I will submit the question to every reader of the Appendix, whether, free from any comment, it is not patent that the Congress was not called to decide upon the best routes for an interoceanic ship canal, but only upon what was *possible* via Panama.

M. de Lesseps announced : "That which struck us most, is the enthusiasm of the United States of America in favor of the establishment of a canal at Panama."

We may ask with surprise, when and where was this enthusiasm manifested ? I saw nothing of it, nor was it conveyed by the Government of the United States, in sending me to present the plan for Panama, and to submit the other surveys and reports made under its orders. I again quote M. de Lesseps: "Lieut. Wyse and his companions have rendered us an account of the mission that they undertook. Seven of them set out; four are dead in those wilds, where one is only able to effect a passage with a hatchet in the hand."

"They have then returned, and have had the honesty to declare to us that in their view a canal was impossible in the regions that they had returned from exploring." This seems sufficient to dispose of the historical sketch of M. Hertz, given on page 10 of the proceedings,

as follows : " The French Committee of Study for the Interoceanic Canal [in consequence of the completion of the surveys alluded to by M. de Lesseps,] thus found itself able to submit to an Interoceanic Canal Congress a collection [of information] upon which it would be able to pronounce intelligently. It is known with what alacrity the most learned men from all countries have responded to the call." To show the sufficiency of our information previous to these surveys of Lieut. Wyse, was the object of my paper, read Oct. 1876, in reply to a pamphlet of M. Drouillet, who came to this country to obtain assistance in making further surveys. The closing paragraph of my paper was as follows : " I may add as a personal conviction, that however long and seriously the search may be continued for ' results ' by surveys, nothing can or will be developed so advantageous as that which the surveys of our Government present for your consideration." Lieut. Wyse's survey undoubtedly destroyed preoccupations in Paris, and so far was useful to them ; which they might have effected at less cost by a more thorough examination of the work that had been done by our Government.

Notwithstanding what M. de Lesseps said respecting the assertions of Lieut. Wyse as to the impossibility of a canal in that region, we find in Lieut. Wyse's last report a tabulated statement of routes, among which is the Tuyra-Tupisa, at an estimated cost of 600,000,000 francs. I quote again M. de Lesseps: "I have consulted M. La Valley, and he has replied that it (would be) decided for a canal *à niveau,*—that it was a public sentiment. I will permit myself to sustain that opinion." Again: "M. La Valley has studied the question of a tunnel; he believes it certainly possible." He says, "it is only a question of cost."

This Society will be surprised to find, on reading all that M. de Lesseps has justly said of the high qualities of M. La Valley, as given in the Appendix, that when the resolution was voted on, he, as also some other distinguished engineers of the French Society, were designedly absent. To the fact that these eminent engineers have not given the sanction of their names to what, by others, was regarded as *possible* in engineering, is probably due the discredit shown to the decision of the Congress.

I quote again M. de Lesseps : "In my belief we should not make a canal with locks at Panama, but a canal *à niveau;* that is, I believe, the opinion of the public, of which I am the organ at this moment."

Here we see that, instead of studying the question as an engineer, and in its economic conditions relatively with other routes, M. de Lesseps pronounces himself to be the organ of what he believes to be public opinion. Happily for the public, its supposed demand could not swerve M. La Valley and others of great reputation.

I call attention to the remarks of M. Peralta, as given in the Appendix. This learned and able Minister of Costa Rica to our Government is well known to many of you personally. His suggestions were not to be considered. M. de Lesseps wished nothing more embodied in the resolution than whether a canal *à niveau* via Panama was possible.

The resolution was passed as he desired by such a vote as to call forth an expression of his satisfaction—this, too, supported by the demands of public opinion, as he stated—and yet he is not happy.

I again quote M. de Lesseps: "Since 40 years I have studied the question of the Suez Canal. I have always understood that, for a profit, it is necessary to receive at the least 10 francs per ton. One can perfectly well make the American canal pay double that amount whatever project may be brought about. These are considerations that one is very glad to know for the future."

The humanitarian idea so nicely held out, and especially supported by M. Simonin, is dropped. There remains alone the idea of constructing a canal without reference to whether it is on the best location, but certainly on the line where the concessionists are entitled to receive, by the terms of the concession, 10 per cent. of the stock issued.

The Report of the Commission on Statistics of the Congress gives the tonnage likely to pass through the canal, as follows:

That of the United States..........................	2,000,000	tons.
That of Great Britain..........................	1,050,000	"
That of France..........................	356,000	"
That of all other Powers..........................	356,000	"

In the Bulletin du Canal Inter-Océanique of October 1, published in Paris, in the building of the Suez Canal, there is an article of some length, entitled "Via Nicaragua," in which is set forth in varied terms the egotism of the American Commission on the inter-

oceanic canal Question, as shown in their Report to our Government, and also the same quality shown by our official delegates to the Paris Congress.

If this 'egotism' was shown, as is supposed, in the report, it was simply in the endeavor to promote the public interests in the most economic manner. The narrowness of the views of the Commission is supposed to be shown in recommending lockage for vessels of only four hundred feet in length, and a beam much greater proportionately than that given vessels at this time. Without having the time or patience to look up the French steamers, I will venture the opinion that all of them longer than four hundred feet could be counted on the fingers of one hand.

The 'egotism' of Mr. Menocal and myself at the Paris Congress, so far as I am capable of judging, was confined to a fair presentation of all of the information in the possession of our Government, feeling no very lively interest in what the Congress would *decide*, not *determine*, which belongs to nature, and to the keen appreciation of moneyed interests as to what will and what will not pay, After the adjournment of the Congress an engineer very much in the confidence of M. de Lesseps said to me, "Now that the matter was settled, what amount of money might be counted on in America to promote the enterprise?" I replied that, in my opinion, they would not get a dollar. Evidently, in my 'egotism,' I was wrong—to what extent will only be known when the Bulletin devoted to the canal interests publishes the amounts subscribed in France and elsewhere for the construction of the canal *à niveau.* Without assuming to speak for the public, I feel sure that such a statement would be read with interest.

Looking at the table just given of the tonnage of the different nations, we see the 'egotisms' (interests?) of all of them in form and substance. In the matter of the canal, the interests of the United States now are practically double those of Great Britain, and will become relatively greater, proportionate to the increase of population. Those of France are, roughly, one-third of Great Britain, and yet, if the word *egotism* is a proper substitution for the word interests, she has as much as all the rest of mankind.

In an interview given in the New York *World* of Oct. 9, M. de Lesseps is reported to have said: "If I may say so, I do not think the Americans are very clear-sighted in this matter. They are of

the Anglo-Saxon race, and it is, to some extent, a question of race. The Anglo-Saxon race is unequaled for its power of dealing with the circumstances immediately before it, but I do not think it sees very far in the future. The Latin race has a somewhat wider intellectual horizon."

He regards the Anglo-Saxon race as eminently practical, and without being of it, I can well believe him. Granting his foreseeing power, may we not ask the probable number of Anglo-Saxons on this continent at the end of this century, and at that time, also, of those inhabiting Australia and the Pacific islands? Awaiting this reply, may we not without egotism assume it to be roughly one hundred millions of people? We can leave to M. de Lesseps, with his long view, the contemplation of the end of the next century, the period A. D. 2000. Still, even to our obscured vision, there seems a mighty multitude of men; shall we give it shape in supposing it to number at the least 300,000,000?

Dropping the consideration of humanitarian ideas so unhappily dispelled, and looking at it as a plain business matter, could we not submit the question to the citizens of the two powers first named, whether it would not be worth while to consider the construction of a canal on a *commercial basis*, and with reference to a careful examination of all of the points involved; and if found practicable in that view, do the work, and if otherwise, develop through the United States and the Canadas such additional railroads as would ameliorate the commerce of which they are so largely the factors?

After considering the proceedings of the 23rd in the general session and a part of the proceedings of the Technical Commission of the May 26, as given in the Appendix, we can proceed to consider the vote more intelligently. A resolution was introduced to conform to the wishes, as expressed, of M. de Lesseps. It is as follows:

"The Congress considers that the piercing of an Interoceanic Canal at a constant level, so desirable in the interests of commerce and navigation, is possible, and that a maritime canal, to respond to an indispensable facility of access and utilization which a work of this kind should offer, should be located between the Gulf of Limon and the Bay of Panama."

The official vote, as given in the proceedings, is as follows: Absentions, 12; against the resolution, 8; in favor of it, 78. The most significant figure is omitted. As counted up on the record, 36

were *absent*, among whom were a considerable number of engineers of note, and perhaps half a dozen delegates who were not in attendance during the session.

Had it not been that the expression of my absence from voting was regarded as an "enigma" which has been *solved* in the Bulletin of October 1, I would not have alluded to it. I abstained from voting, on the ground that "only able engineers can form an opinion, after careful study, of what is actually possible, and what is relatively economical, in the construction of a ship canal." I feel sure that it will excite a smile among us to suppose this in any degree enigmatical, and may recall the ideas so ludicrously shown in the comedy of the Irish Ambassador.

In relation to the vote and to the delegates, a pamphlet published in Paris, titled "Panama, 400,000,000 à l'eau," gives the following:

"Let it be remarked that one-half of the members of the Congress were French; they had been chosen by the organizers of that assembly; 34 members belonged to the Geographical or the Society of Commercial Geography of Paris. What was their competency to decide between a canal with locks or on a sea level? Fourteen other members were engineers or assistants of some sort on the Suez canal. What was their impartiality to decide between M. de Lesseps and others? And, among the others, if one takes count of personal friendships, and of the prestige exercised by a great name, how many more will remain?"

No one will deny that among the French delegates to the Congress were men eminent in every branch of engineering science, and others of the highest character as men of science; the same may properly be said of the foreign delegates; they were men of character and special attainments, usually having relation to the subjects that would concern a canal, if not its construction.

As regards the engineers of Holland and Belgium especially, where the land is so flat and the rainfall so small, their practical experience of a head of water would be confined almost to tidal action. However able they may be, they had not, so far as I know, the practical experience of Intertropical America that made Sir John Hawkshaw so competent an authority.

Engineers in other branches would naturally adopt the opinions of the hydraulic engineers, and, so far as their consciences would permit, be disposed to support the opinions and wishes of M. de

Lesseps, especially if expressed emphatically, as found in the Appendix. They would say very properly, the *execution* of the work was for M. de Lesseps, and not at all their affair. He had asked them to say that the canal *à niveau* was possible, and they had obligingly done so. He did not think it worth while to ask his honorable *confreres* if they thought Panama the best canal route; indeed, it would not have been prudent to do so, as he had determined that the canal should be built at Panama, *à niveau;* as expressed by an engineer very much in his confidence, "If they found it possible, the first thing was to get the money; the next was to build the canal in the best manner that they found possible." Even a great general needs the "sinews of war;" the public who made the demand through M. de Lesseps to have a canal *à niveau* should not desert him so cruelly; he has met them fully half way in reducing the cost of construction one-half as given by the Congress, and in still further shortening the time for the construction of the work as given in his provincial tours, beyond that assigned by him in the Commission on the 26th, as shown in the Appendix.

I do not propose to discuss the terms of the concession fully, as found on page 281 of the report of Lieut. Wyse. I will point out some features that seem to me objectionable in the extreme.

The Canal Company agrees to transport, gratuitously, all persons in the civil and military service of Colombia, their baggage, arms and ammunition, and if the company is not provided with vessels suitable for their transportation, to pay their passages, and for the transportation of armaments and ammunition.

The Government of Colombia is to receive semi-annually five per cent. of the gross receipts of the company for the first 25 years, six per cent. for the second 25 years, seven per cent. for the third 25 years, and for the remaining 24 years eight per cent., at the end of which time the canal reverts to the Colombian Government.

The Company is "authorized to reserve ten per cent. of the shares for the benefit of the founders and aiders of the enterprise."

The only hope for a stockholder would seem to be in the extraordinary impost of ten francs per cubic metre, not on the gross tonnage or weight of the vessel and cargo, but upon the cubical contents of a parallelopiped represented by the length, breadth and draught of the vessel! Lieut. Wyse supposed that this measure-

ment might amount to 30 francs per ton, which, if imposed on ordinary cargoes at ordinary prices, as wheat, would make a voyage from San Francisco around Cape Horn preferable in economy.

Looking at the terms of the "concession," as it is called, and the whole matter from beginning to end, the wonder is that the subscriptions were so large, rather than that they were so insufficient for the purpose of constructing a canal.

When Lieut. Wyse was before a Commission in the Congress he was questioned as to the Panama Railroad and its franchises, and replied that he had made a satisfactory arrangement, by which the Canal Company would gain two millions of francs yearly, but gave no further explanation as to the arrangement.

So far, in general, we have been regarding the aspects of the interoceanic canal question from other points of view than our own, with occasional objections or remarks thereon. Let us now look at the question from our point of view.

After the adjournment of the Congress it seemed to me that its high authority, and that of M. de Lesseps, who does not in the interview overstate the confidence with which he has been regarded in France, would deprive many peasants of their hard earnings; what kind angel protected them Heaven only knows. So far as the English and our countrymen were concerned, the decision of the Congress did not seem to me likely to inflict injury, other than a delay and an uncertainty as to the time of commencement of a great work.

In my report to the Secretary of State, which many of you have doubtless read, I made the following deductions relating to the Congress:

That personal interests, arising from a concession for the construction of a canal, are unfavorable to a relative consideration of natural advantages as between two or more routes; that such personal interests did exist was quite apparent from first to last; and the "concession" was frequently partially discussed or alluded to, especially in the committees or sub-committees.

That the discussion in Paris has shown that hereafter in the examination of the question only the Nicaragua and Panama routes need critical examination, and that sufficient information exists as to all other routes.

That the canal *à niveau* by the Isthmus of Panama, either with or without a tunnel, has been shown to be hopelessly impracticable, if considered as a commercial question.

That a general and special knowledge now exists among European engineers relative to the subject of a ship canal across the American continent, which did not exist prior to the assemblage of the Congress in Paris.

In view of actualities, it seems proper that the Government of the United States should consider the question of the interoceanic ship canal as still undetermined, notwithstanding the report of its commission on the subject; which has received acceptance by the people of the United States, and by our able civil engineers, inasmuch as it has not received a criticism.

Should this be regarded as advisable it would seem necessary to form a commission of the ablest engineers of our army, and to invite the ablest civil engineers of our country, and as well invite all the governments who were represented at the congress in Paris to send their engineers, all to join in full discussion, and having equal powers, with the view of removing it from all extraneous influence of "concessions," or other objects than the consideration of the construction of a ship canal across this continent, capable of fulfilling the demands of the world's commerce, under the most economic conditions.

I have learned that the suggestion as to a commission was maturely considered by our Government, and was regarded as unnecessary, in view of a supposed unanimity of the people of the United States in favor of the Nicaragua route.

It seems to me, however, that this fact, which I think undoubted, does not do away with the great advantage of the discussion of the subject by the ablest engineers; especially if, after a close study of the Nicaragua and Panama routes as presented by the surveys, they should visit both localities for the purpose of verifying any part of the work desired, and of the existence or non-existence of material for construction, and the methods which could best be employed in the execution of the work. This done, so far as human action can go, the question will be presented with the least possible condition of error—the locality where the canal should be made, or whether a canal should be made at all.

When it seemed to me that our Government was not disposed to call a commission, I wrote, at the suggestion of a gentleman of position and influence, to Sir John Hawkshaw, presenting the advantage that the subject would derive from a personal inspection of the Nicaragua and Panama routes, either by him or some able engineer appointed by the Society of Civil Engineers of Great Britain, accompanied by another appointed by the Society of Civil Engineers of France, and also another by our own Society, or, if our Governmeut thought proper to detail Gen. Weitzel, U. S. Engineers, or any other competent officer who has had large experience in hydraulic works. As yet I have received no reply.

The public is aware of the willingness of General Grant to assist in this great work, under such conditions of organization of a company and of a concession as would enable it to be prosecuted vigorously and effectively. He has given the subject his careful attention for years; is well satisfied as to the route, which possesses a certainty of realization by development; he appreciates fully the great importance of the construction of the ship canal for the commerce of the world, and especially for the full development of our West Coast.

It is gratifying to observe that there is an universal expression of opinion as to the advantage which the construction of the canal would derive from having General Grant at its head. The expression is unanimous that it would ensure an economical, intelligent, and vigorous prosecution of the work, and its completion within the shortest time, and that it would have all of the conditions of practical utility and permanency that could be secured.

Recent information, from the most reliable sources, gives the assurance that the intelligent people and Government of Nicaragua are in entire accord with this movement, and instead of embarrassing the question with impossible conditions, will do all in their power to forward the great work.

To sum up the whole matter, we may well desire that our countrymen should know what canal route will best serve the commerce of the world, in which our countrymen are so largely interested. This is eminently a question for the ablest engineers to pronounce upon. Exact information will be presented in a prepared form by Civil Engineer Menocal, U. S. Navy, for discussion by the Society of Civil Engineers

of the United States, showing the quantity of work that will be found necessary on the Panama route at the ocean level, and also by way of Lake Nicaragua, with a lockage of 107 feet above the ocean. It is really not a question of what we may desire, but actually only of what Nature, whose forces are ceaseless and tireless, will permit. To enter into an ill-advised struggle with them is to be defeated in the end, at whatever cost or continued effort. The labor and expense of constructing a ship canal, under the most favorable conditions granted by Nature, will be great, but the result attained will be the grandest that man is capable of achieving for the convenience and extension of the commerce of the world.

Through this discussion we may hope that all of the advantages as well as the difficulties, positive and relative, on those routes, will be fairly developed—not upon fanciful presentations, but upon sufficient information through calculations.

I have taxed your patience in an endeavor to show the present aspect of the ship canal question, and have now only to point to the importance of the forthcoming calculations in detail, and the irrefragable results obtainable from their full and fair discussion.

Gen. Egbert L. Viele, of the Council, then read the following letters:

Letter from Frederick M. Kelley.

[Before reading the letter of Mr. Frederick M. Kelley, Gen. Viele said: Mr. Kelley has spent 27 years' time and over $120,000 in cash in promoting the success of a ship canal without locks through the American Isthmus, and during that time has sent to the Isthmus seven different surveying parties and procured two governmental expeditions to examine all the feasible routes via the Atrato and San Juan valleys during the years 1852, '53, '54 and '55. The reports of the engineers, Messrs. Troutwine, Lave, Porter, Kennish, McDougall, Sweet and General Michler, who had charge of those surveys, can be seen in the public libraries.]

No. 153 West 45th Street,
New York, December 7, 1879.

My Dear Sir: Your favor of Nov. 26, inviting me to be present at the meeting of your Society on the 9th to hear Admiral Ammen's Nicaragua Ship Canal paper read, I received in due time, with thanks; but on account of serious illness in my family I will not be able to attend.

I would be very glad to see the Admiral, as it was my good pleasure to make his acquaintance some years since in Washington; notwithstanding I have no confidence in the enterprise of which he is so zealous and able an advocate.

Twenty-seven years' study of the question, and an extensive intercourse with men engaged in shipping interests in this country and Europe, have convinced me that a *short sea level canal*, with good, safe harbors, which will require no dredging or other improvements to keep open, and which can be reached safely at all times on a wide, open sea, is what the commerce of the world demands, and will have sooner or later, cost what it may.

These important and necessary conditions the Nicaragua route does not afford, as it is 180 miles long, requires 18 or 20 locks, so liable to get out of order in the wet, decaying Isthmus climate, and has no good natural harbors on either ocean.

A canal via the San Blas route will give us a deep, wide cut through the narrowest part of the isthmus, through which vessels may pass from ocean to ocean quickly and cheaply on an even keel, without the expense, dangers and delays of locks, save one tidal lock to control the high tides of the Pacific.

A ship, at the rate of three miles per hour, could be towed through the San Blas canal in 10 hours, and thus 100 going from the Atlantic to the Pacific, and 100 from the Pacific to the Atlantic, 200 ships could pass the Isthmus at this narrow point in 24 hours with perfect ease. The same ship going at the same speed would require 70 hours to pass the Nicaragua canal, including delays at its numerous locks, even one of which, if disabled, would detain the ship no one can tell how long—perhaps weeks or months. It would be a great misfortune to build a long, many-locked canal like the Nicaragua, as that would result in constructing another one at the narrowest part of the Isthmus.

The San Blas route surveyed by Messrs. McDougall, Sweet, Foreman, Rude, and Fountain in 1864, and *partially* examined by Commander Selfridge in 1871, is but about 30 miles long, of which 10 miles is the Bayano river, easily, for a trifling expense, made navigable for ships, thus leaving only 20 miles for canalization. Of this, however, 7 miles is a tunnel, which the engineering skill of this day, with steam and compressed air drills now in use, can drive, without serious difficulty, the same as they have the Hoosac, Mont Cenis, St. Gothard, and other tunnels in this country and Europe, which, 25 years ago, with the old mode of hand-drilling, would have been thought impracticable.

In attempting to solve so great a problem as the best and only route for a ship canal, it is important that additional surveys should be made, especially of the San Blas route, which is much the shortest of all proposed, as by this means a lower and

shorter pass will doubtless be found by flanking the sugar-loaf shaped hills which extend through that part of the Isthmus.

The party should be in charge of a competent army officer like General N. Michler, who, in 1858, by order of Congress, made the very creditable and able survey of the Atrato Truando route for a canal without locks, via the Atrato Valley.

As we are building the canal for all time, and to satisfy the ever expanding wants of commerce, it is the height of folly to locate it where dangerous floods and almost bottomless swamps will destroy it, and thus render useless the undertaking which has cost millions of money.

The safest and most reliable material to excavate in that country is rock, and the *more miles of rock* the canal passes through the more safe and durable will be the structure, the less walling will be required to keep the banks from falling in, and the less will be the cost of maintenance after the work is finished.

Of about 30,000,000 of cubic yards of materials to be removed on the San Blas route (which is much less than on any other route excepting the Atrato-Napipi), about 25,000,000 is rock, and hence the canal located there would be more safe and solid, and cost very much less to maintain it in the future.

This, in the long run of years, is of very great importance to the stockholders, as every railroad man in the country fully comprehends. If it costs all the receipts to maintain the work, where will the shareholders get their anticipated dividends? I have had careful estimates made by the engineers employed, and the total estimate of the cost of the canal is $104,000,000. The estimate of cost of the tunnel, 80 feet wide at the water line, and 120 feet high from the bottom of the canal, is $54,000,000.

Yours, very truly,

FREDERICK M. KELLEY.

CHIEF JUSTICE DALY,
President of the American Geographical Society.

Letter from Nathan Appleton.

NO. 10 COMMONWEALTH AVE., BOSTON,
December 3, 1879.

CHIEF JUSTICE DALY,
President of the American Geographical Society.

DEAR SIR: I beg to acknowledge, with thanks, the receipt of your letter informing me that Admiral Ammen is to read a paper before the Society, at New York on December 9, on the Nicaragua canal question, and inviting me to take part in the discussion that will follow it.

It will be impossible for me to be there, as I have an engagement at Washington on the following day, to attend the quarterly meeting of the United States Board of Trade.

All I could say would be to vindicate the earnest efforts and the honest intention of the International Congress held at Paris last May, under the presidency of M. Ferdinand de Lesseps, to decide upon the best route for a canal across the American Isthmus.

I certainly believe that its decision in favor of a tide level canal by Panama was the right one. I think that, if the same Congress should meet again and discuss the question for a month instead of a fortnight, it would come to exactly the same conclusions. Moreover, I believe that if an American Congress should be convened at New York, it would arrive at this result, which is, that the only canal which can respond to the demands of commerce is a straight cut from ocean to ocean, without locks, and without a tunnel; and for this the only place thus far known, on the long stretch of the American Isthmus from Tehauntepec to Napipi, is at Panama.

The line which was selected by American engineers for a railroad, thirty years ago, stands unchallenged to-day as the best place for that other road of travel and communication—a canal.

I see no difficulty in building a canal by Nicaragua, nor would its expense be very great; but I contend that when it is done, with its seventeen locks, more or less—a great ascending and descending water staircase, to utilize the reservoir of the Lake of Nicaragua—it will be a mere curiosity of engineering, but of no practical use, for it will not enable a sufficient number of ships to pass through it per day to encourage them to make the attempt.

I am not willing to accept this as the "American plan"; for I say it is paying a very poor compliment to the intelligence of our people to suppose that they will endorse any but the best project for a ship canal.

The engineers who have been examining the line by Panama since the decision of the Paris Congress declare that the difficulties in the way of a canal there are less even than they had imagined.

When M. de Lesseps shall have gone there and looked at the ground himself, as he proposes to do very shortly, if he, too, states that a tide level canal is possible at Panama, as he has proved it to be at Suez, then I suppose the world will accept his decision.

We can congratulate ourselves upon the interest General Grant takes in the canal question; and you can judge how much M. de Lesseps counted upon his co-operation, for he offered him the first honorary presidency of his company—the only possible position he could offer in a company which had no legal existence—as the most conspicuous citizen of our land.

If these two great men will work together to build a canal in the right way and in the right place, there is little doubt but that it will soon be finished.

The canal opened through the American Isthmus must be the highway of the world, secured by absolute neutrality. There should be no national jealousy as to which nation will take the initiative in building it; but how can it better be done than by the joint action of the people of the two great republics on either side of the Atlantic ocean—France and the United States?

As I cannot attend your meeting, I desire to present the following resolution by letter:

"*Resolved,* That the American Geographical Society takes proper steps to give M. Ferdinand de Lesseps a fitting reception on his arrival at New York, and that he be invited to deliver an address on the subject of the Interoceanic Canal."

Asking you to read this letter, if possible, at the meeting, I have the honor to be

Very truly yours,

NATHAN APPLETON.

Letter from Walton W. Evans, C. E.

The following letter from Mr. W. W. Evans, member of the Council, was preceded by one to the President of the Society, in which Mr. Evans expressed his conviction that the San Blas route was preferable to the Nicaragua and Panama routes, in which he states that he agrees with M. de Lesseps that the canal to be built should be a tide water, or sea level canal; and that, to be safe, reliable, and at all times ready for quick transit, it must not be on a line of drainage, in such a country as the Isthmus—a region where, for more than half the year, the heavens pour down floods of water. He told M. de Lesseps, in Paris, that he never could build the canal on the Panama route, as proposed by the Congress, and says that when M. de Lesseps reaches there he will find the physical conditions very different from those on the Isthmus of Suez, where he had a rainless region, and was required simply to dig in the sand, with no obstructions in vegetation, or rivers to contend with. In our Isthmus, on the contrary, there must be encountered continuous floods of rain, rock covering nearly the whole distance, and vegetation so dense that one can scarcely see into it, with which are united pestiferous influences from insect life and other causes Mr. Evans calls attention to the fact that earthquakes occur nearly every day there, and says he thinks that this earthquake element has not been duly considered by Admiral Ammen and others, who advocate a canal with locks. He has seen houses so twisted by earthquakes that no one could open or shut a door in them; and what, Mr. Evans asks, would be the efficiency of a canal, if the locks became so warped that no power could open or shut the huge gates that would be required?

Mr. Evans says further in this letter, that he has had seven years' experience in canal building; that he has crossed the Isthmus at Panama many times, and lived in earthquake countries; that he has studied the subject of a canal across the Isthmus for more than thirty years; and flatters himself that he knows as much of what is required as most of the gentlemen who are now discussing the question.

Having been requested by the President, in consequence of this letter, to attend the meeting of the Society at which Admiral Ammen's paper was to be read, Mr. Evans being prevented from doing so by illness, sent the following letter. Before reading the letter, Gen. Viele said that, being himself an engineer, he deemed it proper to say that Mr. Evans was considered by the profession one of the ablest engineers of the country.

SANS SOUCI, NEW ROCHELLE, N. Y.,
December 5, 1879.

Chief Justice DALY,
President of the American Geographical Society.

My Dear Judge: I received your kind note of Nov. 23. I am still troubled with a terrible catarrh in my throat, and when I venture out I have added asthma, and then can hardly move. As long as I remain in the house, I am pretty well. I will try to write my opinion in reference to the Interoceanic canal, so it can be read when the matter is discussed before the Society. I was invited by M. Lesseps to be a deputy at the Paris Congress. I was in Berlin, but excused myself from going by saying that I could not hear anything, so I could not join in the discussion, but I would write a paper, or rather a letter, to my brother-in-law, M. C. A. von Hernert, who lives in Paris, and was a delegate to that Congress. I wrote it hurriedly and sent it. I never knew if it was read or not. I sent a copy of it to Mr. Evarts, but I do not know if he read it or not. I will look up this letter and send it to you to read. I consider this canal the most important matter in the line of progress that is now before the world; it is of vast importance to England, but it is of still greater importance to the United States. England cannot much longer keep her eyes shut to the injury the Suez canal is doing towards destroying her grip on the trade of the world, and I fully believe in the truth of the remark made by Michel Charlier, that the Suez canal was an artery that if kept open would bleed England to death. Her only power to counteract this influence is to join us, and cut the Isthmus canal. I see by the papers that the influence of Admiral Ammen, backed by Gen. Humphreys and Carlilo Patterson, will be so great that it is a matter of difficulty to counteract it, but I would like to have my opinion in the matter put on record in our Society; it can be summed up in a few words; it is this—that a canal built on the Nicaragua route will

be when finished a total failure, and all the money invested in it utterly sunk, for the day is not far distant when the trade of the world will demand that a canal be built between the two oceans on the shortest route, and on the most direct line, regardless of the difficulties that may be encountered. This route is the "San Blas route." It is acknowledged to be the route by Totten, Troutwine, and Sweet, all old canal engineers, who have lived on the Isthmus and know it well, and this is also the opinion of Mr. Kelley, who has spent a fortune in surveys to find a proper route for this very canal. I hope in a few days to be able to put this matter in better shape for you to read to the Society, but I wish here to say that if we now turn our backs on the San Blas route in fright, merely because it calls for a big tunnel to be cut, and because it may possibly cost in first outlay a little more than the Nicaragua canal, we will in a few years be ashamed of ourselves, and confess that we had not a quarter of the pluck the Spaniards had two hundred years ago, when they cut the "Desaguadero" in Mexico, a work that called for the excavation of three and a half times as many cubic yards of rock as would be required to cut a ship tunnel ten miles long, 160 feet high, and 80 feet wide. Our weak-kneed people, who get frightened at the idea of a tunnel, should go to Europe and study tunnelling as done there. I found over 200 tunnels between Nice and Spezzia, on the edge of the Mediterranean, cut and used for a very limited railway travel.

The line of the St. Gothard railway is a perfect marvel for tunnels. Nearly one-fourth of the whole line is in tunnels. The great or Summit tunnel is $9\frac{1}{4}$ miles long; and in seven places on the line—three on the Swiss side of the St. Gothard and four on the Italian side—they have tunneled into the sides of the mountain in great entire circles of 1,000 metres diameter merely to get distance and keep the line to their fixed maximum gradient of 1 in 40, or say 132 feet to the mile. And what is all this terrible expenditure for? Why, merely to rehabilitate the trade which the Suez canal has opened for them, and which the people of the Mediterranean enjoyed, and out of which they built their great cities and filled them with wealth up to the time when Vasco de Gama discovered, four hundred years ago, the route to the East by the Cape of Good Hope. England made this route her own, and out of it she made herself the mistress of the seas, the storehouse of Europe, and the richest country in the world. The time has come for a new deal: the centres of trade are seeking new homes; the gold and silver of the western slope and the cereals of the eastern slope of America are becoming elements in the great problem of moving and fixing the money granary of the world. Bishop Berkley was prophetic when he claimed that the course of empire traveled towards us; and so was the English poet Webb when he wrote, fifty years before our Revolution, the lines—

> "Rome laments her ancient fame declined,
> And Philadelphia becomes the Athens of mankind."

I beg pardon for letting my pen run at random over five sheets. I commenced at first merely to say that I could not come to the meeting of the Society's Council to-morrow, as I dare not trust my throat in the cold.

Yours ever sincerely,

W. W. EVANS.

At the conclusion of this reading the President of the Society, Chief-Justice Daly, said:

It has been said, as I am informed by M. de Lesseps, that the late Emperor Napoleon was in favor of the Panama route. I received a letter this afternoon from our Fellow, Mr. Samuel B. Ruggles, who, as the Society knows, has paid great attention to the subject of canals, which letter was accompanied by an extract from an address delivered by Mr. Ruggles some time ago, in which it is shown that the late Emperor was in favor of the Nicaragua, but not of the Panama route, in proof of which Mr. Ruggles quotes in his address several passages from a pamphlet published by Louis Napoleon, to which Mr. Ruggles requests me to call attention this evening. There is not time at present to read all that Mr. Ruggles has submitted, but it will be printed with the proceedings of the meeting. We have invited several gentlemen to be present this evening who have made the subject of this interoceanic canal an especial study. We have with us Mr. Menocal, who was a delegate to the Paris Congress; Mr. Bogart, the Secretary of the Society of Civil Engineers; Mr. Gardner, the head of our State Survey; Signor de Franco, of Nicaragua, and Mr. Frank de Y. Carpenter. I do not know that any of these gentlemen are prepared to make any remarks, but I think the Society would be gratified to hear observations from any one of them upon the paper and the letters that have been read. I confess to have been impressed with the statement of Mr. Evans, that the earthquake element has not been duly considered by those who advocate the construction of a canal with locks, and as there are several gentlemen here who must know a great deal about the effect of earthquakes upon the Isthmus, I think we would all be very much gratified to know what they think of this objection. I should also say, in this connection, that Mr. Evans transmitted to me to-day a copy of a long letter in favor of the San Blas route, addressed to a member of the Paris Congress, which letter we will publish in our Bulletin. He accompanied this communication with a private note, containing a remark which I

think I may take the liberty of quoting. It is this : "I have given my opinion as to the best route against my own private interest, and have no interest of any kind in the San Blas route." I will now take the liberty of asking Mr. Menocal what he thinks of Mr. Evans' objection, that the constant occurrence of earthquakes will have the effect on the Isthmus of warping, dislocating, or rendering otherwise unmanageable the heavy wooden gates of locks, and would add, that we would like to hear from him upon any of the questions involved in the consideration of this subject, for there is no gentleman present whose opinion is entitled to greater weight.

Responding to the invitation of the President, Mr. A. G. MENOCAL, Civil Engineer, U. S. Navy, said :

I am not prepared to make a speech in regard to the Nicaragua route, or any of the routes, but I will try to answer some of the objections raised by the letters just read. In regard to the earthquakes, I have to confess that earthquakes are very frequent in Nicaragua, but they are only slight shocks, that never did any damage to life or property, or in any way altered the levels of the waters in the lakes, rivers, and wells. And, I would ask, what damage could such earthquakes do the locks of a canal that would be of such serious character as to be regarded in the light of affecting the questions of the construction and maintenance of the work ? It might crack the walls, but that damage could be easily repaired. But what effect, on the other hand, would earthquakes have upon such a tunnel as that proposed on the Panama route,—one an hundred feet wide and one hundred and sixty-eight feet high, as proposed. And we have them very near Panama sometimes. Only a year ago they had an earthquake in Santandea, where a whole town was destroyed, and fifteen hundred lives lost by it.

In regard to the objection of Mr. Appleton, concerning the locks necessary on the Nicaragua route, all admit that a tide lock will be a necessity of the route he advocates, and this will restrict the capacity of the canal as much as any number of locks along the route. If it takes a vessel an hour to go through the tide lock, it will take a dozen hours for twelve vessels to pass, irrespective of what the conditions beyond may be.

With regard to the liability of locks to get out of order, I think the American engineers are the ones who should speak least of that

objection. Locks are in constant use on the canals of England, of Holland, of France, in fact all over Europe and in this country, and their working is no longer a thing of speculation and theory. The locks have been in use a great many years in the North Sea canal, and the engineers of that canal, though friends of M. de Lesseps, and advocates of a sea level route for an interoceanic ship canal, admitted that they could pass a ship every hour through the locks proposed on the Nicaragua route. That would carry all the tonnage through the canal that will be wanted.

The Nicaragua canal, I claim, could be built for one-third as much as that by the San Blas route; not that I admit that the latter is practicable, but assuming for the present the claim of its advocates that it is. I think, from an engineering point of view, that the San Blas route is impracticable; but suppose its difficulties could be overcome, it would cost three times as much as the Nicaragua canal, which will answer all the demands of trade just as well. Of the latter, nature has provided a great part already in lake and river, in which a steamer can go at full speed, and the portion remaining, the sixty-one miles of canal that will have to be constructed, is what should, fairly, be compared with the San Blas route. On that portion, sailing vessels will have to be towed, but so will they on the other. On Lake Nicaragua they can take advantage of the winds, the same as if at sea. But, in considering the San Blas route, the long towage out of the Bay of Panama to the Pacific must be taken into account, and should properly be added to the estimated length of that canal. It may be all very well for vessels that pass through, but what about vessels coming to the canal from the Pacific side? How are they to convey an intimation, upon their arrival at the bay, to the canal officials, that they desire to be towed in? It would be necessary to keep steam pilot boats constantly on the look out for such vessels. The difficulties of navigation on the San Blas route would be at least equal to those on the Nicaragua route.

Chief-Justice Daly: How about harbors at either end of the Nicaragua route?

Mr. Menocal: We would have to build two harbors, one at each end of the Nicaragua route, but their expense would not be very great. The item of harbor improvement is covered in the estimate stated by Rear-Admiral Ammen. The plans have been submitted to several commissions of engineers, and fully approved,

and the Paris Congress approved of them entirely, without any criticism.

I have no doubt that when M. de Lesseps arrives at Aspinwall, the information he will there receive concerning the recent floods of the River Chagres, will satisfy him of the impracticability of the Panama canal. As I stated at the Paris Congress, that river sometimes rises thirty-six to forty feet above the level of the sea at low water. The effect of this has already been clearly stated in Rear-Admiral Ammen's paper. When I stated this fact at the Paris Congress, it was doubted, and I was asked if my information was from actual surveys, or was only gleaned from the statements of the natives. It was, I said, from actual surveys ; yet they insisted that the River Chagres only rose seven metres. Now, they can satisfy themselves of the fact that I stated. During the last flood the river has risen forty feet. The town of Gatun was partially carried away, and parts of the railroad were submerged to a depth of several feet, during eight or ten days, by the floods.

I might remark on the difficulty of building a tunnel such as will be required on the San Blas route; but a discussion of the engineering difficulties to be apprehended would take a long time and hardly be understood. The great difficulty will be the making of excavations below the level of the sea. I have very carefully examined what takes place in the wells, and in the gold and silver mines and other excavations in that country, and I say that as soon as we reach about one hundred feet below the surface of the ground, the filtrations become so great that many of the richest silver mines have to be abandoned, because pumps could not be obtained of power and capacity sufficient to keep them dry. Through the loose disordered masses, the results of volcanic action, that make up the Isthmus, water filtrates with the greatest ease everywhere, and in great quantities. At the summit of the Panama railroad, its highest point, which is 282 feet above the level of the sea, there is a spring of water that supplies all the engines on the road; and in addition so far exceeds the demands upon it, that it runs down the gutters on both sides of the road.

What then will be the effect of digging below the level of the sea? From my knowledge of the geological formation of the Isthmus, I believe that, so far from encountering solid and regular strata, as they suppose, they will meet with all kinds of materials—limestone, trap-rock, sand, conglomerate volcanic deposits—every-

thing, indeed, without regularity, and in the most bewildering variety, even within the narrowest limits. I have seen workmen there, in the digging of a well to a depth of no more than fifty feet, go through ten different kinds of materials.

CHIEF-JUSTICE DALY: Do you know the character of the rock through which it is proposed to cut the tunnel on the San Blas route?

MR. MENOCAL: I cannot say I know it positively, further than my well-grounded knowledge of the geological formations generally throughout that country assures me that, instead of one regular and consistent character of rock, will be found many different varieties. It has been said that the mountain through which the San Blas tunnel is proposed, is a solid mass of granite, but that I believe to be an error, and I should not be surprised if we found there a soft limestone, such as we find at the headwaters of the River Chagres, not far from that route.

The President then called upon Mr. JOHN BOGART, Secretary of the Society of Civil Engineers, who said: I think the majority of the engineers are still wanting a little more information in regard to the Panama and San Blas routes. The surveys made by Mr. Menocal at Nicaragua have been very full, and we are thoroughly well informed as regards the difficulties to be met there, and the modes proposed for overcoming them, but, certainly, as has been shown by Mr. Evans's letter, the idea of a direct short route from ocean to ocean, strikes engineers as an excellent solution of the problem. The thing in the way is this great tunnel. It certainly is practicable for engineers to discover—if we can get, as Mr. Kelley suggests, a proper survey of the San Blas route—just what the character of the rock is. We hardly like to say that it would be impracticable to put a tunnel in there. It is a question, of course, of possibility, and therefore I think that most of us agree with the suggestion made by Mr. Kelley, that before we positively decide on this matter, we ought to know more thoroughly the character of the rock at the San Blas crossing of the range. The subject is large enough, I should say, Mr. President, to be discussed when we have more time. There are several engineers ere in the audience, whom I see, who, I am sure, could give us an interesting discussion of this subject, but it is rather late to-night to call on them.

Mr. T. Bailey Myers moved that the discussion of this important question be continued by opening the rooms of the Society for that purpose on stated evenings, to be hereafter assigned.

In putting the motion, CHIEF JUSTICE DALY spoke as follows:

The Council having felt that, as this is a great international question, in the proper disposition of which we have as deep an interest, and perhaps deeper than any other nation, it is the duty of the American Geographical Society to acquire and diffuse as much information as can be procured, and to have the question of the best route discussed, as far as it can be, upon the ascertained facts. With this view, it is the wish of the Council to continue the discussion at the rooms of the Society, where, without any present limits as to time, the fullest opportunity can be afforded for the expression of views, and where everything that is said can be taken down and published in our Bulletin. This duty seems especially to devolve upon us more than any other American institution, for the reason, among others, that we have greater facilities than any other body in the country, with perhaps the exception of the Smithsonian Institution, for disseminating throughout the world the information elicited by such an investigation. We appreciate the necessity for, and therefore propose, having a more full examination of the comparative merits of the different routes than took place at the Paris Congress, which, I am free to say, was hardly a discussion at all; in which a very positive conclusion was declared by a vote of the majority of the body, with certainly very little preliminary investigation. We, on the contrary, think that it is a great, important and practical question, in which every opportunity should be offered for a more thorough examination and discussion of it than has yet taken place, and it is our purpose that this shall be done, as far as it is in our power to accomplish it. We intend, therefore, if the body of the Society approve, to continue what we have commenced to-night at the rooms of the Society, upon stated evenings, until all that can be done in this way has been done, assuming that those only will take part in it who have made the subject a matter of special investigation, who have some information of practical value to communicate, or views to express upon the ascertained facts; that it is not to be limited to an oral discussion, but open to the reception and consideration of any written communications upon the subject that any one may think proper to make. The question to be first settled—which is the most practicable route, under all the circumstances—is, in my judgment, a question for civil engineers and physical geographers, and not for congresses.

Such a question is not in a condition for final decision until all the explorations and surveys have been made, which the present state of our knowledge indicates should be made. We have done more in the way of explorations and surveys to ascertain the best route for the canal than any other country, at least so far as respects the cost, completeness, and value of the surveys, and we are naturally, therefore, not very much impressed—I say it in no spirit of discourtesy—with the action of a body coming together at Paris under the name of an International Congress, undertaking to dictate for the whole commercial world exactly where the canal shall be built, upon the report of two naval officers. I say this not in review of reports by Lieuts. Wyse and Reclus, or of the route adopted by a vote of the majority of the Congress, but simply as dissenting from this mode of attempting to foreclose all future inquiry upon the subject, and to give, by a preliminary proceeding of this nature, a kind of international sanction to the inauguration of what was simply a commercial enterprise. When it shall be fully and exhaustively ascertained what is the true route, in view of the general interest of commerce, the facilities for the construction of the canal, the outlay that will be required to make it a satisfactory and permanent work, and what security it may reasonably be expected it will afford for the capital invested in it, and for a moderate interest upon that capital—when, I say, all this is ascertained, the question of the canal will be settled without the instrumentality of international conventions or congresses, for the commercial world is pretty well agreed upon its utility, and the conviction is now very general that every year of the world's progress will but render more apparent its indispensable necessity. When all the information that can be gathered is obtained and duly weighed, commercial sagacity will determine whether the canal should be built, and where it should be built, and if it is to be, commercial enterprise will, in my judgment, find the means of doing it. This, as I understand it, is the American view of the question, and we are a practical people, accustomed to handle great enterprises, and in doing so, to possess ourselves first of all the facts before deciding what to do.

On motion of Mr. Jas. T. Gardner, seconded by Mr. Francis A. Stout, a vote of thanks was tendered to Rear-Admiral Ammen for the paper furnished by him, and a copy requested for publication by the Society. Carried.

APPENDIX A.

Proceedings in the General Session of the Canal Congress in Paris, May 23, *and in the* 4*th Commission, May* 26, 1879.

(Report by Rear-Admiral DANIEL AMMEN, U. S. N., Delegate of the United States Government to the Paris Congress.)

A MEMBER : I see that the Congress is drawing to its close. It will soon be called upon to decide between the different projects which have been submitted to it.

Shall the canal pass through Lake Nicaragua, or by way of Panama?

I beg leave to recommend the Atrato project to the attention of the President; leaving out the matter of expense and its technical question, I believe that it would have advantages for the interests of the country.

M. DE LESSEPS*: I would ask that you will be kind enough to present your observations to the commission charged with the examination of the question.

The representative of the Fifth Commission has now the floor.

THE SECRETARY OF THE FIFTH COMMISSION : The Fifth Commission had announced its report for to-day's session ; it met yesterday, and, after discussion, became convinced that it would be impossible to hand in its report before being fully advised of the decision which the Statistical Commission will adopt. This commission has informed us that they will complete their decisions at the sitting of to-morrow, Saturday. We have been obliged, therefore, to adjourn until the communication of the decision which will be made at that session.

M. DE LESSEPS : We will have a general session, then, next Tuesday, at 9 o'clock, to hear the different reports before the closing session, which will certainly take place on Thursday evening, at 9.

Now, gentlemen, permit me, as the President, to make a *resumé* of what has been done at the sessions of the Congress. You have heard the different reports which have been laid before you. What strikes us the most is the enthusiasm of the United States of America in favor of locating a canal at Panama ; they have been at considerable expense in sending out explorers to that

* The President of the Congress.

Isthmus. It is unquestionable that America has hereby given us proof of her impartiality, and of her devotion [to the interests of a canal]. Let no one, hereafter, come to tell us that she does not wish a canal because she has a railroad. Admiral Ammen and Commander Selfridge, in their study of the projects, have expressed to us the desire to come to an understanding in order to secure something practicable.

Commander Selfridge has presented to us his plan for the Napipi-Atrato route—a plan without locks, except the two by which to descend from the level of the Atrato to the level of the Pacific. M. Wyse and his companions have reported on the mission which they undertook. Of the seven who went out, four died in those wilds, where one cannot advance a step except with hatchet in hand. They have at length returned, and have had the frankness to declare to us that, in the countries which they have just explored, a canal is impossible. When I saw them, it was in company with Monsieur La Valley, our illustrious Suez engineer, who has already designed for us so many machines, and who, in like circumstances, will well know how to invent new ones. I have consulted M. La Valley, and he has replied that the decision would be for a canal *à niveau*—that this would be the general opinion. I shall permit myself to sustain this opinion. Although I am not an engineer, my experience has often served me in this matter. It is very necessary to decide quickly; if we should occasion delay, we will be the cause of great injury to commerce.

The most distinguished engineers of France have written some articles on this subject, which you have been able to read in the *Revue des Deux Mondes*. Some of them are in favor of a canal with fifteen locks, that is to say, twice as many as any one has already constructed in a work of this kind; and this for the very simple reason, that they think it impossible to construct a tunnel. Moreover, I learned a fortnight ago that, as the result of the soundings very recently made, we cannot count upon an outlet from the canal into the Pacific; but, at this day, when dredgers have come into use, we have learned by the regimen of waters that what could not be done some years ago, is now perfectly practicable. It would have happened so to us at Suez (*i. e.*, we would not have an outlet there) if we had left our harbors without cleaning them out. God only knows at what we should have arrived in a century or two more; we have learned now to secure the equilibrium of the waters.

I do not wish to interpose the least difficulty in the labors of the Technical Commission. The savants have the means of foreseeing

very many things, but there are some facts which are incontrovertible. I will ask the commission not to formulate any resolutions which could arrest certain plans. I would wish them to say only Yes or No; whether it appears to them possible to construct a canal *à niveau*, which seems to be the desideratum of the whole world. M. La Valley has studied that question of a tunnel; he believes it clearly practicable. It is, he says, only a question of expense.

I will not enter into the scientific question. I will only ask the Technical Commission to tell us precisely what would be the expense of a canal *à niveau;* what estimates can be made of that expense, and especially what the cost will be in the future (after construction) for canals *à niveau*, or for those with locks. Governments can en-encourage such enterprises; they cannot execute them. It is the public then on whom we must call, and when you come before them, they will ask of you (if it is a canal with locks) what will be the expense in the future.

I will express my opinion. I consider that a canal with locks would retard navigation. From the experience we have had at Suez, a ship must not now be delayed. There are a thousand Philistines there who can load a ship of 400 tons in an hour. It is to be remembered, also, that it costs a ship of a thousand tons, 2,000 francs for every day's delay. I have often been consulted on this subject; I have always replied, by dispatch, that ships must not be delayed in their passage; they are informed that it will be well for them to wait the rise of the tide when they cannot be sure of their being able to steer satisfactorily. The larger number of them, in spite of the delay, prefer to wait some hours for the tide. This is certainly an obstacle, and we thought of remedying it at Suez by means of tide locks; but we have been obliged to abandon that idea. I go every year to Suez. I have often met there with large ships which were passing with the ebb tide because they were in haste; I have witnessed the slowness of their sailing. We must not forget that the large vessels which come from England must make their voyage in twenty-one days. I have often seen these English vessels of 2,500 tons sheltering an entire regiment. These brave people are on the deck, with their wives and children, for you know they never travel without them. We look on them from a distance; they look like anything but soldiers.

In my opinion we ought not to make a canal at Panama with locks, but *à niveau*—that is the opinion of the public whose organ I am.

Don Manuel M. Peralta: I have listened with the most profound respect to the opinion which M. de Lesseps has just expressed. It appears to me he has forgotten to say that the Government of the United States appointed a scientific commission of three members, and that these gentlemen successively examined the different projects, from the route by the Atrato to the passage through the great Lake Nicaragua, as well as the canal *à niveau*, with a tunnel alongside the railroad from Colon to Panama; but, after a long and very conscientious study, and repeated explorations, they decided that the plan of Commander Lull was preferable from a humanitarian point of view, since it would save a great many lives—a circumstance which had not been foreseen when the Panama railroad was built; and, besides, that by this route sailing vessels could always pass with favorable winds, which cannot be hoped for on other routes, especially at Panama. The American scientific commission decided on the Nicaragua route, since it was demonstrated that the Panama route was impossible. Is there no ground for taking its decision into consideration?

M. de Lesseps: The Government declared that there was no impossibility for a canal with locks, and that it could not assert that a canal *à niveau* was impossible. The Government, in its fairness, was absorbed in one idea only. It acted on the principle that nothing was impossible.

M. des Grand: Since a commission has been named, composed of members of the bureaus of the different sections, would it not be well that this commission meet to formulate a programme of questions to be resolved? A programme which can be distributed in time for us to reflect upon them before the last sitting of the Congress? In this way, instead of being limited to the one question, which is best of all the canals?—or which is the same as asking, which is the best of all the governments?—we can enlighten the public more by increasing the number of questions. I wish to say that what is understood to be the best of all the canals, is not, perhaps, that which costs the least.

M. de Lesseps: The different sections can send in their memoranda to the Technical Commission, which will examine all their plans.

M. des Grand: If we have before us this question only—Which is the best of the canals? I fear we shall not reach its solution.

M. de Lesseps: We shall reach it in time.

M. Des Grand: I address the Central Commission, composed of the President and the secretaries of all the committees, and I ask it

to formulate a programme, to which the Technical Commission will have to reply.

M. DE LESSEPS : We cannot impose a programme on that commission.

M. RUELLE : I will limit myself to three questions, which I address to the Commission of Navigation, to facilitate the labor of the Technical Commission.

We have been told up to the present time that there would be tide locks. I wish the Commission of Navigation to pronounce clearly on this point, since on the construction or the non-construction of tide locks may depend a difference of height in the tunnel.

Then a second question as to the form, whether ovoid or elliptical : Which of these is most economical for constructing a tunnel, and in which does the arch offer the most resistance? I wish to know if the width necessary for the passage of sailing ships can accord with the elliptical form, and if we must be limited to a width of 22 metres for the tunnel.

My third question to the Commission of Navigation is this : What comparison can be made between the difficulties of a ship passing through several locks, and the passage of the same ship through a tunnel of a certain length? In a word, will a tunnel ten kilometres long present the same obstacles to navigation as the sailing of a ship through nine or ten locks?

M. VOISIN BEY : From the questions which M. Ruelle addresses to the Commission of Navigation, I wish to set aside the first one ; that is, whether guard locks ought to be constructed on the Pacific side. I add that this question can be answered only among ourselves.

M. SIMONIN : As the Congress must close its sessions next Thursday, and as our Honorable President has just told us that we must examine the cost of a canal *à niveau*, whatever it may cost, I ask permission to present some observations precisely on what our President has just said. We who have met in this body are not only engineers, geographers, theoretical scientists ; it has seemed to me that we are also manufacturers, seamen and business men, and in the preceding general session our Honorable President said that in this matter it was not necessary to have the assistance of Government, and that we must address ourselves to the public only. Now, it has been announced that the transit of the future canal will reach the figures of six millions of tons, which I consider a very large maximum, and I have the right to so

regard it, if I compare it with the figure of three millions of tons passing through the Suez canal, which is an important point of the world's commerce. Whatever may be the importance of the Panama canal, I doubt whether it will ever exceed that which the Suez canal has attained. I doubt it for more than one reason, because the Suez canal leads to China, which represents more than seven hundred millions of people, while, in America, you can only count on markets representing scarcely one hundred millions. Including countries as far as the Straits of Magellan, you will not have the millions of China. I believe, then, that the figure of six millions of tons, which you have fixed upon as an average, is exaggerated. Since we ought to treat it simply as a business affair, we should correct this estimate. We are going to make it an affair of the long future, as M. de Lesseps said; but I believe that this would be to proceed on a very bad principle. We are going to adopt the canal *à niveau*, cost what it may, even though it should be five milliards —the estimate which has been made by a person of great authority in the United States. I say that we should examine the question from another point of view. We should inquire what a canal with locks might be; besides asking specialists how many ships could pass through these locks in twenty-four hours—whether a sufficient number could pass for the number of tons which has been just spoken of. I am not the advocate of any company or any canal; I have no reason to adopt one system rather than another; but I do not wish that we should go out from this body with a negative vote. If we decide for a canal which would be impracticable, it would be unfortunate. We ought to treat the question as business men. It is necessary that this canal shall give large dividends to its stockholders. Without that we shall have played a singular part. I desire that our Honorable President will tell me if I have misunderstood him when he asked the Technical Commission to decide for a canal at any cost, provided it was *à niveau*.

M. de Lesseps: I have said that the commission would pronounce for one canal or another. We must decide. We ought not to go out from this body without making a decision.

M. Spément: I would remark to the assembly that we were already acquainted with the opinion of M. de Lesseps. He said in the Geographical Congress of 1875 that he had always advocated the use of canals *à niveau* everywhere, where their construction had been shown to him possible. I believe he thinks a canal *à niveau* would be preferable via Panama. If that should be impossible there, we must go to Nicaragua.

M. de Lesseps : Why not a fresh water canal——

M. Fontane : I ask leave to make a single observation in reply to M. Simonin. He said that he accepted the figure of 6,000,000 tons having to pass through the Interoceanic canal as a maximum. I wish simply to appeal to the patience of M. Simonin, and ask him to await the report which the President of the Statistical Commission, M. Levapem, will present in a few days to the assembly. He will find in this report all the elements necessary to form a definite opinion. He added that he accepted the figure of 6,000,000 of tons as a very large maximum, because there were but 3,000,000 of tons which passed through the Suez canal. I desire to recall to the Congress, that at its first meeting, in a report which I had the honor to present, I stated precisely the reason why the Suez canal has now a traffic of 3,000,000 tons. It is simply because steam navigation almost alone can properly utilize the Suez canal, and the shipbuilders cannot make enough steam vessels to carry on the traffic which exists. I showed by official figures that the traffic between the western and the eastern world through the Suez canal would reach 10,000,000 tons. Consequently, the figure of 6,000,000 tons that M. Simonin considers as a maximum for an Interoceanic canal, comparing it with the 3,000,000 tons of the Suez canal, becomes almost a minimum, compared with 10,000,000 which could pass through the Suez canal.

A second opinion of M. Simonin bore upon the sum that the Panama canal might cost—a sum which is reckoned at some milliards ! We would like upon this point again to appeal to the patience of our honorable colleague, and ask him to await the developments of the report of the Technical Commission, charged with estimating the cost of the canal. I have wished simply to appeal to the patience of M. Simonin. It is perhaps asking too much.

M. Simonin : I do not see why on two occasions M. Fontane, my honorable colleague and friend, has made an appeal to my patience. It seems to me that I speak with much calmness, and that I have always given proof of much patience and tranquility ; consequently, M. Fontane has wished to be witty, but I do not admit his objection. As to the figures that I have made use of, I would be glad if he would be good enough to demonstrate to me that they are exaggerated. We are doing a work in the interest of humanity. I shall experience great satisfaction when 10,000,000 tons will have to pass through the canal we desire to open.

The figures that I have cited have been made by conscientious

persons; show me that we are wrong—I ask nothing better; but it is useless to occupy the attention of so numerous and busy an assemblage in making personal questions.

M. DE LESSEPS: There is nothing personal in that question, in what has been said; it has only been the occasion for us to learn the opinions of those in listening to whom we have always great pleasure. M. Simonin has said that we have ten francs, since the Suez canal has been opened to navigation, and that, considering the number of vessels which pass through the canal, we had a return of 10 per cent. In truth, we have already received large returns, and we have been obliged to reduce our tariffs. Through whatever route the Panama canal will pass, it will shorten the distance more readily than the route of the Suez canal does. During the forty years that I have studied the question, I have always understood that, for a profit, it is necessary to receive at the least ten francs per ton; we can readily make the American canal pay double this, whatever may be the project that is brought about. These are considerations that one is very glad to know for the future.

COMMANDER SELFRIDGE makes known to the assembly, through the interpreter, that the people of the United States have no preference for any project. Everyone in America is convinced of the special competence of the Congress, and whatever may be the result, the nation will accept with eagerness all the decisions which may be taken here.

M. LAROUSSE: I will ask permission of the Congress to put another question in addition to those of M. Ruelle; it is to compare the difference of distances which the proposed canals would give, considering the principal regions which they would be called upon to benefit. It is certain that the Congress, in order to make a decision, will also have to estimate the time judged necessary to pass through the different canals, etc.; all of which points, I think, require some explanation.

M. EIFFEL: I desire that the Commission on Navigation will be good enough to give us some explanation upon the inconvenience of locks, if the number of them were reduced. In other words, would canals with locks present much less inconvenience with less than half the number of locks than by the plan as now presented?

M. DE LESSEPS: If no other person wishes to speak, I will remind the assembly that our first general meeting will take place Tuesday next, at 9 A. M., to hear the reports of the First and Fifth Commissions, and that the closing session is fixed for Thursday.

The adjournment took place at 6.45 P. M.

Views of Walton W. Evans on the proposed Canal between North and South America, addressed to M. C. Auguste von Hernert, for submission to the Paris Congress.

Berlin, *May* 9, 1879.

Monsieur C. Auguste von Hernert.

My Dear Sir:—When I left Paris last November, I promised to write to you my views and opinions on the projected canal between North and South America, to run from the waters of the Atlantic to the waters of the Pacific, so that you could bring these opinions to the notice of that far-seeing and most intelligent cosmographer, Monsieur Le Count Ferdinand de Lesseps, at the Congress which is to assemble in Paris this month, to consider and discuss the subject of an Interoceanic Canal. I should have written this letter before, but for my long sickness with Roman fever in Egypt.

I will not attempt to discuss or offer opinions on the traffic that this canal will command, or the amount of tonnage that will pass through it, or the amount of benefit it will be to those nations interested in it, for they have been most thoroughly discussed and written on, and tables of tonnage made out by most competent compilers of statistics in both America and Europe. They all agree in the great importance and benefit to commerce that will result from the construction of this canal. I think that they all agree in one important point, namely, that the direct returns for the use of the canal will make it a commercial success, and I think that every one who has studied the subject will admit that the indirect returns to the three great commercial maritime powers, England, France and the United States, must be immense. The isthmus that divides North from South America has been for ages looked upon as a point or region that must some day be of great commercial importance. The Spaniards, in the day of their great power, made it a capital offense to speak of or discuss the matter of a canal between the two oceans. That long-headed Scotchman, William Patterson, the founder of the Bank of England, established a colony on the Isthmus of Darien, at Caledonia bay, and would no doubt have made it a place of great commercial importance, but for the war waged on him by the king of Spain. Backed by all the power and influence of the king of England, he and his followers were driven from there, dying from hunger, and from that time to this the Mandingo

Indians, a tribe of about 800 souls, have held that region, as the supreme power, against all comers. William Patterson established his colony with the firm belief that in time it would be one of the greatest commercial centres in the world. There were over thirty pamphlets and papers published before the year 1700 on the general features connected with this colony and region. They all, I think, agreed in the healthiness of the climate and the productions of the soil. No man that I know of has ever been allowed to cross the isthmus at this point for nearly two hundred years without the consent of the Mandingo Indians, except Doctor Cullen. I hold that a full and complete survey of the Darien route from the Bay of Caledonia direct to the Gulf of San Miguel, or some navigable point on the Savanna river, has never been made with the view of tunneling the ridge which is met with near to the Bay of Caledonia. The examination of this route by my friend Captain (now Admiral) Provost, R. N., also the second exploration of part of the route by L. Gisborne, C. E., and also the careful survey of this route by Captain Selfridge, U. S. N., have nothing in them to condemn the route unless it becomes a settled question that the canal must be built without resort to tunneling. I fear very much that the United States government have decided to adopt the Nicaraguan route as the best for this great enterprise. I cannot but look on this as a great error. I will in as few words as possible attempt to explain my reasons for considering this an error, and then give my own opinion on what route should be adopted. I have taken much interest in this matter, and studied it with care for more than a quarter of a century.

Before I was born, and that includes more than six decades of time, the people of the United States looked forward to the time when they could enjoy the benefits resulting from a route to China and the east, by passing through a canal to be cut across the Isthmus of Panama, and at the same time contemplated the possession of the Sandwich Islands as a stopping place on the route from Panama to the mouth of the great Yang-tze-kiang river, in China. To show how great errors may exist in reference to geographical relative positions, I would state that there was not probably a man interested in the subject that knew that the Sandwich islands were not by two thousand miles in the line of the shortest route from Panama to China, and probably but few men in the world knew that the most direct route,

irrespective of land and water, from Panama to any point in China, would pass to the east of San Francisco, and in traveling the great circle pass far to the north of the Sandwich islands. It may be asked what has this to do with an Isthmus canal? It has not much, but it shows, *cæteris paribus*, the most northerly route for the canal is the best, considering China and Japan as the objective points. There is another point in connection with a route to the east by way of the canal, which has not been touched on, as far as I have seen, in any recent reports or writings; it is *the pacific character of the Pacific ocean.*

It is now nearly thirty years since the British government published an elaborate and apparently exhaustive report on mail routes from England to the east, and discussed or brought to the attention of the public not only the time occupied and cost of existing routes, but also other routes that might some day be occupied. Admiral Moresby, R.N., then in command of the British fleet in the Pacific, brought this report to me to read, and said the author, in discussing the Panama route, had not said a word in reference to a most important feature—the pacific character of the Pacific ocean. I beg you to excuse my digression from the main question—the canal. I will return to it and try to stick to it.

It is now some years since the Congress of the United States authorized the President to appoint a commission to examine and report on an Isthmus canal. The President selected three most eminent men to form this commission—General Humphreys, the Chief of Engineers of the United States; Captain Carlisle Patterson, U. S. N., Chief of Coast Survey; and Commodore Ammen, U. S. N., all men of great ability and reliability in their professions, and in the works that have been intrusted to their charge; but none of them were civil engineers, nor had they ever any connection with tunnels. Under their direction and superintendence, a number of surveys were made of probable, possible and historical routes, routes that were said to possess favorable features, and routes that had been partially examined before. No one can read the long, elaborate and illustrated reports made by the commanders of these survey expeditions without being struck with the great amount of labor and fatigue these surveyors went through in this tropical region, where the heat is intense, vegetation dense, matted and thorny, insect life pestiferous in the extreme, and where the rain

comes down much of the time in a deluge, as if the heavens had been burst asunder ; they deserve all credit for the display of indefatigable spirits that carried them through their arduous labors. There appears to have been two ruling and governing points in the minds of these commissioners in conducting their surveys and in making up their final conclusions :

First.—That the route to be adopted, was the one found to be the cheapest to construct.

Second.—That routes requiring tunnels must be ignored, and in view of these points they concluded to report in favor of the Nicaragua route.

I once thought the Nicaragua route was *the* route, but on more study and reflection, I came to different conclusions:

First.—That the subject is too important to be decided by the matter of first cost.

Second.—That the Nicaragua route is too long, requires too much locking up and down, is deficient in good harbors at both ends, and is particularly unhealthy at Greytown, at the mouth of the San Juan river, where the Gulf terminus must be.

It strikes me that the United States will not be in an enviable position if it guarantees its credit to the amount of fifty millions of dollars, or more, to a canal company, to build a canal on the Nicaragua route, and then finds that the world has awakened to the importance of the subject, and demands that a canal shall be cut on the shortest route to be found between the two oceans. This route is the San Blas route. From the Bay of San Blas on the Atlantic side to the Bay of Panama on the Pacific side, the distance is only thirty miles ; probably it is less on a direct line. This route requires a tunnel of nine or ten miles long ; this is the stumbling block that appears to be the insurmountable object in the minds of many. But it ought not to be, in this age of steam drills and improved explosive compounds. If the Spaniards could cut the *desaguadero* (a work which Humboldt called the greatest work of human hands), two hundred years ago, in Mexico, merely as a precaution to save the city in case of a great flood (this desaguadero was an open cut, and as I understand the dimensions it required three and a half times as many cubic metres of rock to be removed, as it would require to cut a canal tunnel ten miles

long, 150 feet deep and 80 feet wide), surely we in this age of invention and great mechanical undertakings should not shrink in fright from a ship-canal tunnel ten miles long, and particularly when we look around and see the Mont Cenis tunnel completed, the St. Gothard tunnel nearly completed, and the Simplon tunnel seriously contemplated, all of nearly the same length as the ship tunnel in question, all connected with other severe features in the railway lines they are on, all for the limited traffic of a railway, and all for what might in comparison be called a local business; while the Isthmus canal tunnel, and the canal itself, is the greatest project before the world at the present day, and is but a small link in a great net-work of ocean navigation, extending for thousands of miles in every direction, and to every nationality of any importance in the world. This little link in a great centre is left for man to construct, while all the rest to the uttermost parts of the earth have been built by the Supreme Being, and given to man for his use and benefit, free of cost for construction and repairs. Can it be that there is not spirit and will and pluck enough in the people of the 19th century to cut this little canal, open this highway, and bring the Orient closer to the doors of the Occident?

I have an idea that the location of this canal is of too great importance to commercial interests to be decided by the mere matter of first cost, and I further believe that if the merits and demerits of the Nicaragua route, and the San Blas route were laid before any great political economist, cosmographer or statician for a decision, and he was told that the former would cost fifty millions of dollars, and the latter one hundred and fifty millions, he would decide in favor of the latter. I do not wish to convey the idea that the San Blas route is going to cost any such amount as $150,000,000. I have a belief that if the works are directed by skilled, experienced and capable engineers, that the canal can be completed in the very best manner inside of $150,000,000, and that it can be made to pay a good interest on that sum. I am much pleased to see in a recent paper that Mr. Kelley, of New York, advocates the adoption of the the San Blas route. Mr. Kelley is entitled to great consideration in the discussion and settlement of the question, as he has devoted more time, attention and money to it than any other living man, having made under his direction, and at his sole cost, surveys of eight entire routes.

It is established by the surveys of Col. Totten, for the Panama railway, that the mean level of the two oceans is the same; that there is little or no tide on the Atlantic, but that there is a tide on the Pacific side of about 25 feet, or say 7.62 metres. This has been brought up as an argument against a tide-water canal across the Isthmus, namely, that a current would be created in the canal, injurious to it and to navigation. Let us examine this by the test of figures. The mean level of the two oceans being the same, there would be a period in each day when the waters of the Pacific would be 3.81 metres higher than the waters of the Atlantic, and another period when they would be 3.81 metres lower. Taking the canal to be 30 miles long, this gives at the moment of extreme elevation or depression of the Pacific a surface gradient of 0.127 metres per mile. This may be considered a most healthy gradient, and could be used to advantage in passing ships in either direction. The gradient of the Ganges canal in India was originally 18 inches to the mile, equal to 0.457 metres, but this was changed to 15 inches per mile, equal to 0.38 metres, and has been worked at that in either direction ever since its completion, and without difficulty or risk, as far as I know. This gradient is over three times the gradient that would exist in the Isthmus canal, if built as a tide-water canal, without any locks at either end. Earthquakes have been another cause for fear in constructing tunnels in this region, but I am convinced that such fears are groundless. As far as I can learn, this San Blas region is peculiarly free from earthquakes, while they are frequent at Panama, but not strong enough to topple over some arches and some tall stone buildings in that city that are in decay and about 200 years old. We have constructed arches and tunnels on the Oroya railway, in Peru, where earthquakes are frequent; there are 62 tunnels on that railway, one of them being at an elevation of 15,648 feet above the level of the sea, equal to 4,769 metres, and to this day I have not heard of any disturbance to arches in these tunnels from earthquakes. (The Summit tunnel and some others are not yet arched). I had constructed and erected in Peru, on a railway, an iron bridge with a central pier 252 feet in height, which has been in use six years without showing any movement from earthquakes or other causes. I had constructed and erected on a railway in Peru an iron bridge, which has cast-iron upper chords and posts; it has been in use over 24 years, and is still per-

fect. It is in sight of Arica, which was entirely destroyed by the great earthquake of 1868. Near to this bridge lies the hull of the U. S. man-of-war *Wateree*, that was carried by the tidal wave of that earthquake over the railway and left in the sand. I have great faith in our being able to construct a tunnel for a ship canal that will be safe against the destructive effects of earthquakes. The advantages that a canal constructed on the San Blas route would have over one on the Nicaragua route, are :

First.—It would be only 30 miles long, while the other would be 181 miles long.

Second.—It would be a tide-water canal, while the other calls for locking up 107 feet, and down 107 feet.

Third.—It has a good harbor at the northern end, and facilities for constructing easily a good harbor at the Panama bay end, while the Nicaragua route has no harbor at either end.

Fourth.—It is a healthy region at the terminus, while the Nicaragua route must terminate in a notoriously unhealthy region on the eastern coast.

Fifth.—The cost of repairs and conservation must, I think, be greatly more in favor of the San Blas route than the ratio of length of the two routes, namely, 30 to 181; as the Nicaragua canal, except the lake part, will be more exposed to accident on account of the embankments, locks, and other mechanical structures on it.

Sixth.—The San Blas canal can be passed through in six or seven hours, while a Nicaragua canal would occupy five days or more in the transit.

The immense amount of rock to be excavated for a canal tunnel of ten miles in length, and the time taken to do it, will, no doubt, frighten some people not thoroughly acquainted with such works, but when compared as to time required, it should not be estimated (with railway tunnels as a basis of calculation) to consume time corresponding to the amount to be excavated, for it should take no more time to drive a mile of heading for a ship-canal tunnel than it takes to drive a mile of heading for a railway tunnel, and when the "heading" is once driven through, an army of men could be put to work on the whole length night and day; and when they came to the springing line of the arch, or before that, the work ought to be done per cubic metre as cheaply as if it was in open cutting, or cheaper and quicker, as the frequent rains which fall on the Isthmus in vast quantity drive the men from their work for whole days at a

time. This would not occur in the tunnel, nor would the tunnel be washed or filled in by these rains; the tunnel once cut and arched, would stand for ages without requiring repairs, or being subject to "breaks," as is so often the case with elevated "reaches" of canals, occasioning suspension of all traffic sometimes for weeks. The Nicaragua canal cannot be made entirely free from accidents of this kind, while a tide-water canal is positively free from all such trouble. I will now close this already too long document by stating what I would do if I were "king," and no one to say nay to my acts.

First.—I would make complete surveys of the two routes—the Caledonia bay route, and the San Blas route—to find which was preferable, as regards length of tunnel, and also in other points, such as harbors, total length of canal and drainage, etc., discarding all other routes as objectionable.

Second.—If I found the San Blas route to be the best of the two, I would buy the Panama railway and its concessions of all kinds.

Third.—I would get a charter from the Colombian government, allowing me to build, and if they did not give it on fair and reasonable terms, I would take possession of the route and ignore them altogether, for this route is in the possession of the San Blas Indians, as the Caledonia bay route is in the possession of the Mandingo Indians, who have held it for 200 years against all the power of Spain and their successors; they are the supreme power, and if I could not conciliate them by gold and kind acts, I would exterminate them.

Fourth.—I would locate a direct straight line on the shortest route from San Blas to Panama bay, turning neither to right nor the left after getting through the tunnel, except to avoid the Chepo or Bayano river. This line, starting from San Blas, the most northerly point, will run to the east of south, and will intersect the Chepo or Bayano river, which comes from the east, and drains a considerable territory on the south slope of the mountains, nearly as far as Caledonia bay. It has been proposed to run the canal into this river, deepen its bed, and use its channel for the canal for ten miles, to where it debouches into Panama bay; but this I consider objectionable, as this river must be subject to floods, and no doubt brings down at times a large amount of debris from the mountains, chiefly vegetable matter. Through this

whole region there lie on the ground great masses of immense trees, partially decayed. I would avoid this river by cutting a new channel for it for ten miles, or turn the canal to the right, after leaving the tunnel, and make it as free as possible from becoming a drain for anything.

Fifth.—I would send for Monsieur Favre, contractor for the St. Gothard Tunnel, who has more experience in great tunnels than any man now living, and make a contract with him, or some arrangement for the use of his brains or experience. I saw last summer at the St. Gothard tunnel better and more perfect arching than I ever saw before in a tunnel.

Sixth.—I would call together a convention of merchants, shipowners and engineers to decide on the dimensions of the canal and tunnel.

Seventh.—I would locate two tunnels, to be arched, half gothic in form, with a pier between them of 100 feet in width; but I would cut only one tunnel of 75 feet in width (22.86 ms.), sufficient to pass one ship at a time, and when the traffic warrants it cut the other tunnel.

Eighth.—I would drive this work night and day until it was completed and thrown open for the benefit of the world.

Ninth.—I would call on the governments of England, France and the United States to guarantee the bonds of a company to the whole amount of estimated cost; these governments to become the owners of the canal, and all belonging to it, at the end of 100 years, they paying original cost, as determined by a board of their own during construction.

Tenth.—I would make every man connected with this canal interested in its cost, the time it occupied to build, and his own time connected with it.

Eleventh.—I would insist on the whole work being completed in twelve years.

Twelfth.—I would do a great many other things, not necessary to mention here.

I remain, dear Sir,

Your obedient Servant,

WALTER W. EVANS,

Member of the Institute of Civil Engineers of England; of the American Society of Civil Engineers; of the Council of American Geographical Society.

P. S. May 10th.—I find that in the hurried and rambling way in which I wrote you a long letter last night, after my party had gone to bed, that I omitted to jot down one or two points of importance connected with this Isthmus canal matter. They may be looked upon as axioms—at least they run through my brain in that light. They are :

First.—The canal must be a sea-level canal, without locks, unless it may be decided to have a tide-water guard-lock at the Pacific end.

Second.—This canal must not be on a line of drainage, or in any valley subject to inundations.

It is but fair that I should give my reasons for using such strong expressions as "must be" and "must not be." I have been seven years connected with the construction of canals and in the severest school for canal engineering ever known in the United States ; I have had the direction of extensive engineering works in earthquake countries for eleven years, and I have no hesitation in asserting that any canal built in the earthquake country that exists where the Isthmus canal must be built, would soon be rendered useless, if locks are introduced, by earthquakes twisting and warping them, so that the gates could be neither shut or opened. It is a very common occurrence in South America to have a house so twisted out of square that the doors cannot be opened or shut. When an earthquake happens in the night, every one—men, women and children—rush from the houses in their night-dresses before the second shock (the severe one) comes, so as not to get caught in their rooms and unable to get the doors open. To build canal locks with chambers of 75 to 80 feet wide, will call for the most mathematical accuracy in the construction of the gates to make them work at all. If they are warped by an earthquake, they could not be opened and shut.

To build an Isthmus canal in such valleys as the Chagres, on the Panama route, and the San Juan, on the Nicaragua route, would, in my opinion, be the extreme of folly. If the canal was not washed out entirely and rendered utterly worthless, it would require so immense and never-ending expenses for repairs as to eat up all revenues received. You may depend on it that owners of large and fine vessels, freighted with valuable cargoes, will think twice before allowing their ships to enter such a canal as the Nicaragua canal must be if ever it is built.

Has any one ever estimated the number of large ocean vessels that could be passed through the Nicaragua canal each day ? The

huge leviathans that now traverse every ocean are not children's toys; nor are they easily started or stopped, as I had occasion to notice in coming through the Suez canal within the past month in a Peninsular and Oriental steamer, over 400 feet long. Entering the canal from Lake Timsch, our steamer ran into the right bank, the stern swung round and fastened itself in the left bank. The next steamer from Bombay, of the same line, had the same thing happen, and broke off two blades of her propeller. I hope you will bring some of these points to the attention of the Congress that is about to assemble in Paris.

If any one wishes to see what destruction might happen to a canal constructed in a valley on a line of drainage, and depending for its efficiency on "locks" and "dams" as its chief features, let him take a trip up the Lehigh valley, in Pennsylvania, and there he will see (in a place where such floods occurred as are almost daily occurrences in the Nicaragua and Panama region) the ruins of what was once a most admirably constructed canal, having dams of best design and build, and locks of the greatest lift ever constructed. One single flood in the Lehigh river swept out to utter ruin every lock and dam, and almost "like the baseless fabric of a vision, left not a wreck behind." If any doubter, in search of further knowledge regarding the permanence and reliability of canals with elevated "reaches," wishes to store his mind with facts, let him take the records of the Erie canal, where the best "puddle walls" and the most carefully built embankments ever designed and constructed are to be found, and he will see the history of many accidents from floods and wash-outs that occasioned delays and vast expense; and if he has a reflecting brain, with a slight knowledge of the Isthmus region, the idea might dawn on it that such accidents happening in the San Juan valley of Nicaragua, or in the Chagres valley of Panama, could not be repaired as readily, as quickly and as cheaply by ten-fold as they could be in the state of New York.

If stone walls in cement are to be built along the whole length of the embankments of the Nicaragua canal, to prevent rats and roots from boring through and starting little leaks, that soon grow to destructive wash-outs, then the advocates of that route had better add a few more tens of millions to their estimate of cost. Such accidents cannot happen to a tide-water canal. And Count Ferdinand de Lesseps was correct when he said to me, in Paris, that whatever route we adopt, one thing is certain—it must be a sea-level canal.

REPORT OF W. E. JOHNSTON, M. D., DELEGATE OF THE AMERICAN GEOGRAPHICAL SOCIETY TO THE PARIS CONGRESS, ON THE PROCEEDINGS OF THE SAME:

I did not render you at the moment an account of the proceedings of the Interoceanic Canal Congress held in this city two months ago. I was not able at that time to do so.

The subscription has failed, but M. de Lesseps announces that the project is not abandoned, and that he is going to the United States to try to interest the people in the scheme.

As the agitation on the subject, therefore, is to be maintained, and perhaps transferred to the United States, you will need all the data on the subject it is possible to obtain.

For this reason, and because the American part in the affair has been perverted, I feel it to be a duty to go back and give you the history of the proceedings of the Congress and its accompanying incidents as I saw them.

As I have taken the liberty of informing you in previous letters, the French people had come to look upon this canal question as exclusively their own. For many years the press and the public men of the country had talked and acted as if they had a monopoly of the matter. No attention was paid to the efforts of the American government, nor to the surveys of our able naval officers; or, if they were referred to, it was to depreciate their value or to throw doubt on their sincerity. It was even charged in print that these officers were bribed by the railway companies to slur over their work, and not to find a feasible route.

In a country full of money seeking an outlet, this state of things naturally begot a multitude of schemes for an interoceanic canal. You would hardly believe how many people were spending their time and money the last few years on this for them empty bubble, the pretended inertia of the Americans all this time being attributed to the opposition of the railway companies.

All of these schemes were submitted to M. de Lesseps and were encouraged by him. He is the great canal digger; his influence with his countrymen is legitimate and universal; he is kindhearted and obliging, but he is ambitious also—perhaps not more so than other people—and appeared so anxious to attach his name to the successful company that he gave his consent to all.

But it was not till men with prominent names came forward that

he announced publicly his sympathy and coöperation. These men were Messrs. Wyse, Turr and Bixio. Lieut. Wyse, of the French Navy, is a son of a former English minister at Athens, and his mother was a Princess Bonaparte of the Roman branch of the family. General Turr is a Hungarian, and married Lieut. Wyse's second sister. M. Bixio was a brother of the Minister Bixio, of the Provincial government of 1848. He died of fever on the isthmus.

These gentlemen, backed by some bankers and personal friends, made their first visit to the isthmus three years ago, and examined one of the Atrato routes. They came back sick, reported unfavorably, and after some months' consultation, in which M. de Lesseps took a large part, it was decided that Lieut. Wyse should return to the isthmus and look at the Panama route, with the view of making that the affair on which they were finally to settle, and as the affair to which the public in France would be most likely to subscribe.

The survey was made—how imperfectly was afterwards shown in the Congress by the abandonment of all the figures, and of even the plan; the party returned to Paris, and last winter the plan of campaign of putting through the Wyse scheme was organized.

An International Congress was to be called, so as to give authority to the scheme; M. de Lesseps was to preside at the Congress and issue the invitations, and as the President had the right to constitute the Congress as he saw fit, enough French members of the right sort were invited to counterbalance any opposition that might manifest itself. So far as Lieut. Wyse and party were concerned, they sought first to reimburse themselves for the losses already sustained, and for which they were responsible to certain bankers and friends, and this they hoped to do by forming a new company which would assume the responsibilities they had incurred.

This was the origin of the famous Congress. It was not, as you see, a very high-toned affair; it was not intended that it should be. The object was to get out of an old debt by creating a new one, to be shouldered by some one else. The digging of a Panama canal was a very distant and very problematic affair.

But it turned out that the Congress became a very serious and very grave affair. As eminent engineers from foreign countries began to arrive, the hope of carrying out the prepared programme diminished. The great satisfaction which was at first manifested at the prospect of having a large and respectable gathering, soon gave place to sad reflections and sad surmises. The arrival of the

two eminent American authorities, Messrs. Ammen and Menocal, was a deathblow to their hopes, and although those two gentlemen were treated with the greatest consideration, it was felt by the leaders that their coming was a disaster, and that a new base of operations would have to be adopted.

There is nothing, in fact, more curious in the history of caucuses than the evolutions of this Congress.

Not only was the President of the Congress named in advance, but so also were the officers and the committees, and even the work the committees were to perform. Nothing, it was intended, was to be left to hazard. At the first meeting, at which were present the 136 members, and above 300 spectators interested in the subject, nothing was done or allowed to be done but the reading of the names of the members, the names of the committees and their presidents, and an indication of the work they were to do. The first meeting did not last an hour, no one had a word to say but the President and Secretary, and this very summary way of treating the distinguished guests who had come a long way to the "study" of the interoceanic canal project was climaxed at the end by the President hastily adjourning the meeting with the remark: "Gentlemen, we are going to rush this thing *à l'Amèricaine*: we shall get through by next Tuesday."

Thus not only was the Congress packed and manipulated so as to run through hastily and without fail the imperfect and impossible scheme of Lieut. Wyse, but the most distinguished and honorable experts from all parts of the world were invited to give the scheme their aid and to cover it with their responsibility.

It was hardly dignified, therefore, for men holding the high rank of government delegates to take their seat in a Congress which had been gotten up for a certain limited and well-defined object, and in which no proposition outside the programme stood the least chance of adoption.

Fortunately, the American government had given such instructions to its delegates as would meet just such an emergency: they were simply to furnish to the Congress, for its instruction, the facts and figures collected at the bureau in Washington, without pledging the government to anything. Their mission was a mission of good-will, and not of partisanship, and if the Congress did not benefit by it, the government of the United States and its delegates were not to blame.

When it came to the turn of Messrs. Ammen and Menocal to give their figures and estimates of the different routes, a complete revolution took place. The great body of able engineers, who had come to the Congress unpledged to any route, and who had come seriously to study the question without prejudice, were astounded to find that nobody in Europe knew anything about the question. The *exposé* of the American delegates was a revelation, in fact, to the whole Congress. The estimates of Lieut. Wyse were shown to be as fictitious as if made in Paris without ever having visited the isthmus.

From this moment the Congress became a real Congress and not a sham. The facts and figures of Messrs. Ammen and Menocal now formed the only basis to stand upon. It was transformed into a respectable Congress, with real data on which to base a scientific discussion. Three-fourths of the competent members declared that the surveys of Lieut. Wyse were worthless, and M. de Lesseps and the Wyse party were in consternation.

We were now brought face to face with the singular spectacle of a Congress which had become serious and honest, and which saw its way clear to the truth, and yet which was obliged to remain dishonest, and carry out the original plan, no matter by what means.

The reason of this singular anomaly is easily understood. M. de Lesseps, Lieut. Wyse, and the bankers behind them, were pledged to the Panama route, and could not adopt another. That was the French route; they had been long manufacturing enthusiasm for that route; the bankers and the public would not give a cent to any route that was not patronized by M. de Lesseps and Lieut. Wyse. So that to abandon that route was to abandon entirely for France the glory of cutting the interoceanic canal, and that was not to be thought of for a moment. They had been claiming, as I have already told you, for years the monopoly of this question; they claimed all the knowledge on the subject, and to back out now would be to lose all the money they had engaged in the scheme, all the money they expected to gain, which was a mountain, and to lose their popularity besides. The Congress would have been dissolved without a decision rather than to have adopted another than the French route.

But how was this accomplished? M. de Lesseps's galloping Congress was adjourned for several days; we heard no more of rushing the thing through *à l'Amèricaine;* they had to stop to change their base. Lieutenant Wyse, with such of the engineers as were

pledged to his scheme, went to work in secret committee, and labored night and day till they elaborated a new plan, to cover as they thought the objections of Mr. Menocal, and with, of course, a much higher figure of costs. The committee having in charge the estimates on the probable receipts and expenditures of the canal, were instructed by the President to try and make the receipts cover the new estimate of costs, which they did with the greatest ease.

Again, the American engineers, backed this time by overwhelming arguments by Sir John Hawkshaw, showed that the plan was still defective; and again the Congress was adjourned to give time to the Wyse secret committee to get up new figures and a new plan. The Congress, which started off on a gallop, had first dropped into a trot, and was now at a walk. And all to allow Lieut. Wyse to prepare estimates on difficult details which he had never studied on the ground, and which, therefore, were only theoretical.

The majority of the engineers lost their interest in the proceedings from this moment, and became simple lookers-on, while the meeting relapsed back into its original character of a Congress for the benefit of Lieut. Wyse and his party.

The assembly was now in a crisis. On the one side were the engineers, on the other the business men and the speculators. It looked at one time as if the Congress, if called upon, would have voted for the plan of Mr. Menocal by Nicaragua. The charter of Mr. Wyse from the Colombian government exacts the building of the canal by the most economical route, and to build it by the dearest route is a violation, and a forfeiture of the charter. But these difficulties, which were pointed out to the Congress, no longer stopped the proceedings. The Wyse party had now offered their ultimatum, which was an open cut, without locks, and with *deversoirs*, or side canals, the whole to cost 250,000,000 of dollars, and to pay in receipts 18,000,000 of dollars a year.

At this point M. de Lesseps made a long speech. He is tenacious as well as able, and did not propose to suffer a defeat. He commenced by several propositions, which are true, as, for example, that in looking at the map Panama appears to be the right place for a canal; that this route already had a railroad, and a thriving city at each end, which would facilitate the construction of the canal; it could there be built without locks, in his opinion, which was a great desideratum. Finally, he made the statement, which was new, and rather astonishing, but which nevertheless produced a marked effect in favor of his project, that when he commenced

the Suez canal many of the problems connected with it were unsolved, and looked dark, but that as they progressed, and difficulties crowded upon them, men of genius sprung up to meet and conquer the difficulties. The same, he said, would take place in this new enterprise. For every difficulty there would be found a man of genius capable of conquering it. As for the money, there was plenty in France; the enterprise was French, it would add largely to the glory of France, and the money was ready, waiting the opening of the subscription books.

The effect of this speech was enormous. The American engineers had shown that the Panama route, principally on account of the annual fall of twelve feet of rain, was impossible; that it never could be finished if commenced, nor made to pay a dividend if finished: it was all to no purpose; Lieut. Wyse and his committee had but to retire to their consultation-room to find at once in their own heads the figures necessary to head off Mr. Menocal's estimates. It was the game of "I see you, and go you one better," played by men who had no cards, but plenty of money.

The next day the last meeting and the final voting were to take place. The question had now been placed on national and patriotic ground; we had arrived at the moment of "sublime resolutions," of those "sublime resolutions" which have been the glory and the ridicule of France; they were going to carry hundreds of millions of money abroad for the good of mankind in general. It would cost much money, but the money they had; it would require men of genius, but these also they had; the absurd barrier which nature had thrown up between the two seas was going to fall before the force of French genius and the power of French money. It was impossible, even in the absence of any practicable figures, not to grow lachrymose over the Panama route.

Nevertheless, the intelligent chairman was not going to trust the vote to any hazard which could be avoided. He had decided, without consulting the meeting, that the voting should be nominal; that each member of the Congress should be called up in alphabetical order to declare by *yes* or *no* how he voted, with the privilege of explaining his vote by a word, but only by a word; and in case he had much to say, it should be said in writing, addressed to the secretary. By this method of open voting certain wavering Frenchmen were prevented from dodging an affirmative vote.

As the voting went on, certain delegates, by attempting to make

speeches against the project and against the mode of voting, irritated M. de Lesseps to such a point that he suddenly exclaimed, for the first time, and to the astonishment of everybody, that he would take charge of the canal himself, and that they might be sure that if he took hold of it the canal would certainly be cut, and cut quickly, honestly and economically! This announcement electrified the house, not only because M. de Lesseps is much loved and is really the best man for the work, but because it was a plank of safety thrown to a scheme which was being saved with difficulty.

After this the voting was more cheerful, and, when finished, counted up 74 yeas, and 62 nays and abstentions, in a total of 136 registered delegates. When my name was called, I declared that I abstained from voting, on the ground that only one route was put to vote, and because none of the routes had been sufficiently studied. I hope that this course will meet with the approbation of your honorable society. Of the other American delegates present, six in number, three—Admiral Ammen, Mr. Menocal, and Professor Lawrence Smith—counted themselves with the abstainers, on the ground that the work of the Congress had not been sufficiently elaborated, while the other three voted in the affirmative.

If it be thought that the word "abstention" was too mild a word to be found in the mouths of American delegates, it must be stated in extenuation that these delegates were met and surrounded during their whole stay with such a large hospitality, they were so dined and fêted, that they will be excused for lacking the heart to look their entertainers in the face and pronounce so harsh a word as "no."

An analysis of the final vote will show that the able engineers who came to the Congress with their minds free from prejudice, and with a desire to arrive at the truth, are either to be found among the absentees, or among those who abstained from voting.

Thus, as the majority for the Wyse scheme was small, as the neutral experts were opposed to it, and as the Congress from beginning to end was manipulated in the interest of that scheme, it may be said that, in an international point of view, the decision of the Congress was no decision at all, and that it is without force and not binding.

Thus, too, although a great use is being made of this sanction of the Congress, and although the assembly in fact contained in its list of delegates many of the most distinguished engineers in the world, the whole affair was in reality a comedy of the most deplor-

able kind, and should have no weight whatever in any future measures it may be desirable to adopt.

Certainly there was no allusion to politics in the Congress, and the enterprise was honestly intended to be a purely financial one; but every one understood that the bankers who proposed to take the loan, intended to shove the shares into the hands of the people as rapidly as possible; that at the end of two or three years, when the company failed, as it certainly would, the French government, for motives of popularity, might be led to assume a responsibility in the affair, and then the American canal would stand exactly in the dangerous position in which the canal of Suez now stands, that is to say, with a large portion of its stock in the hands of a powerful government, waiting an opportunity when the protecting powers may be in trouble to utilize this stock as its personal interests may demand.

So well did M. de Lesseps understand the need of getting his stock into the hands of small holders, that he undertook at once a voyage through the provinces, to create popularity for it with the rural populations; because in a moment of distress these populations have a stronger hold on the sympathies of the government than the bankers or speculators. In these provincial tours he everywhere gave the impression that the governments of France and the United States were equally favorable to the enterprise; the flags of the two nations were everywhere united over his head when he spoke; and the following extract from one of his speeches, published in a provincial paper, is but a repetition of what he said at all the towns where he spoke: "The Monroe doctrine," he said, "has nothing to do with our enterprise, because it is a private affair, because it is international in its character, and, therefore, neutral. The opposition of the United States is not serious, because their representatives at the Congress declared that the United States came to the Congress to submit themselves to the verdict of the majority, and this verdict has been rendered in favor of the Panama route. Furthermore, the execution of the project cannot give rise to political complications, for the reason that the direct or private aid of any government has not been demanded."

I need not assure you, perhaps, that no authorized delegate of the American government made any assurance of the kind to the Congress, and that so far as I was concerned personally, I seized upon every occasion to assure the members that the American government, in the opinion of those who knew best, was opposed

to the Panama route, because its engineers had shown that it was too costly, and, therefore, not practicable.

But the statements of M. de Lesseps, in his speeches, have been marked by such exaggerations as seriously to shake the public faith in his soundness of mind, and one French newspaper declares squarely that he has entered his dotage, and ought not to be trusted with other people's money.

Another French paper, the *France Financière*, stigmatizes the whole thing as a swindle, and as only a repetition of the transcontinental affair (for which General Fremont and Baron Boildeau were condemned to prison), and declares further that M. de Lesseps is in a fair way to compromise his honor and to tarnish his fair name.

Another paper, the *Crédit Maritime*, declares that the canal will cost so much that it will never pay dividends, that the government will be forced to interfere, and that from that time diplomatic trouble will commence. This paper adds that fortunately the concession of the Colombian government exacts (as I have already stated) that the most economical route should be adopted, and that steps have already been taken to annul the concession. These steps are being taken, of course, by the friends of rival routes, who were cavalierly treated by the Congress, and who desire a revision and a re-examination of all the routes.

In fine, the French have made a grave mistake in engaging themselves recklessly in a colossal enterprise about which they knew little, and this mistake is due in the first place to the fact that they were dazzled by the feat of digging the Suez canal, and by the possession of a great and popular authority in canal digging in the person of M. de Lesseps ; and, in the second place, to the circumstance that for many years past the press and the public men of the country have assiduously propagated the idea that France possessed the monopoly of this whole question.

Under the empire M. de Lesseps would not have been permitted to call a Congress, not even a well-intentioned Congress, on so grave a question, without first investigating, through the legation at Washington, the state of the question in the United States. The failure of this Congress will teach the people the salutary lesson that under the republic they must think for themselves, and not follow the lead of any man.

Paris, Aug. 15, 1879.

W. E. JOHNSTON, M.D.

THE NICARAGUA CANAL: Extracts from Mr. S. B. RUGGLES'S Semi-Centennial Address at New Haven, July 27, 1864.

The picture of our fifty years would be singularly incomplete were it to omit Louis Napoleon, that "mysterious and inscrutable" sovereign, who mainly governs France by governing himself, and preëminently the most commanding object within our field of view at the present hour. Whatever ultimate designs he may entertain in respect to America, and how much soever we may reprobate his manner of reaching the throne, or his recent interference with the affairs of Mexico, we cannot close our eyes upon the unexampled success of his civil administration. He has certainly signalized his reign beyond that of any preceding ruler of France, by the permanent improvement and splendid embellishment of its cities, the vigorous prosecution of its works of inter-communication, the canalization of its rivers, the rapid increase of its commerce, and the immense augmentation of the pecuniary value of the empire * ; not to mention his political performances in the consolidation of Italy, and the recent remarka-

* The value of the real and personal estate of France authoritatively stated in debate in the *Corps Legislatif*, May 7, 1864, was 249,000 millions of francs, about 46,000 millions of dollars. In 1852, it was about 124,000 millions of francs, showing an increase, in twelve years, of about 23,000 *millions of dollars.*

The taxed value of the real and personal property of the United States in 1850 was 7,135 millions of dollars. In 1860, 16,159 millions. Increase in ten years, 9,024 *millions of dollars.* During those epochs, the public works of both nations were vigorously prosecuted.

The \$9,024,000 added to the pecuniary value of the United States, in the decade from 1850 to 1860, was occasioned largely by the increase of our population, shown by experience for seventy years to vary very little from 35 per cent. for every decade. The increase in the last decade from 23,191,176 to 31,445,089 (being 8,254,209), compared with the \$9,024,000 increase of value, shows a rate of \$1,093 (in metallic currency) for each additional inhabitant.

The increase of population for the present decade from 1860 to 1870, may possibly fall somewhat short of the previous rate, but will not probably be less than ten millions for the whole United States, or seven millions for the loyal states. The latter number, multiplied by only \$800 (in metallic currency) for each additional inhabitant, would amount to 5,600 millions of dollars—nearly threefold our present national debt. All we require is an honest administration of our national resources—and a metallic basis for our national currency.

ble extension of the territory and power of France over the African coast of the Mediterranean. It may well be, that his very characteristic declaration, that "France makes it a point of honor to keep rivers and revolutions in their proper channels," *—condensing in a single phrase his whole policy at home and abroad,—has offended the lovers of the largest republican liberty, but every one will recognize his noble and comprehensive statesmanship, in seeking so earnestly not only to recover and reconstruct the canal of Suez, the work of Ptolemy and of Trajan, but to open through the central portion of America, by his proposed canal of Nicaragua, the way to the East Indies, which Columbus sought in vain to discover.

The fact does not seem to be generally known that Louis Napoleon, while a state prisoner of Louis Phillipe, and actually immured in the prison of Ham, deliberately signed a contract to construct the canal of Nicaragua, to pass vessels of 2,000 tons from ocean to ocean, and personally to expend on the work seventy-five millions of francs. It so happened that the progress of the public works of New York, with which I had been officially connected, having been unexpectedly and rather rudely stopped, I had gone to Europe; where my business was to ascertain whether France and England would join the United States in constructing an interoceanic canal through the Isthmus of Panama, to be free to all the nations of the world, and to be forever consecrated to peace. It was on the suggestion, and indeed at the request of the minister at Paris from Nicaragua, that I met Louis Napoleon, in London, in 1846, about a month after he had escaped from prison. To external observers, he certainly then appeared to be very far from the throne of France, so that the conversation between us was comparatively free and unrestrained, although his manner was at times just a little imperial. On asking him if he thought that his proposed canal would yield an adequate revenue on its cost, he answered with a princely air—"Perhaps not; but you *now see me out of my true position ;* and I

*** This imperial sentence, so far as rivers are concerned, is a French paraphrase of Horace's compact description of the Tiber, controlled in its inundations by the vigorous arm of Augustus—"doctus iter melius." Every sovereign, ancient or modern, dignified by history as "the Great," has regarded the improvement of the rivers and the roads of his country, as a duty and an honor. Alexander the Great died at Babylon while clearing the Euphrates from obstructions.**

"must do something worthy of the name I bear." He was then writing a pamphlet, in which he fully and very ably set forth, not only the commercial, but the high political importance of the proposed interoceanic canal. The pamphlet, a copy of which, bearing the autograph of the writer, is now before me, indicates so clearly the exalted objects which he then had in view, and which he has since acquired the power in some degree to accomplish, that I beg leave to read one or two brief extracts. They are of peculiar interest at the present time, not only in bringing boldly out the noblest features of the golden age of civilization we have just been reviewing, but also in manifesting the opinions then entertained by the present ruler of France in respect to the abolition of slavery, not alone in America, but throughout the civilized world.

"The geographical position of Constantinople," says this now imperial writer, "is such as rendered her the queen of the ancient world; occupying, as she does, the central point between Europe, Asia and Africa, she could become the entrepôt of the commerce of all these countries, and obtain over them an immense preponderance; for in politics, as in strategy, a central position always commands the circumference.

"This it what the proud city of Constantine could be, and this is what she is not, because, as Montesquieu says, God permitted that Turks should exist on earth, a people the most fit to possess uselessly a great empire.

"There exists in the New World a state as admirably situated as Constantinople, and we must say, up to the present time, *as uselessly occupied;* we allude to the state of Nicaragua. As Constantinople is the centre of the ancient world, so is the town of Leon, or rather Massaqua, the centre of the new; and if the tongue of land which separates its two lakes from the Pacific ocean were cut through, she would command, by her central position, the entire coast of North and South America. The state of Nicaragua can become, better than Constantinople, the necessary route for the great commerce of the world, and is destined to attain to an extraordinary degree of prosperity and grandeur."

"France, England, Holland, Russia and the United States have a great commercial interest in the establishment of a communication between the two oceans; but England has, more than the other powers, a *political* interest in the execution of this project. Eng-

land will see with pleasure Central America become a flourishing and powerful state, which will establish a balance of power, by creating in Spanish America a new centre of active enterprise, powerful enough to give rise to a great feeling of nationality, and to prevent, *by backing Mexico, any further encroachment from the north.*

"The prosperity of Central America is connected with the interests of civilization at large ; and the best means to promote the interests of humanity, is to knock down the barriers which separate men, races and nations. This course is pointed out to us by the Christain religion, as well as by the efforts of those great men who have at intervals appeared in the world. The Christain faith teaches us *that we are all brothers and that in the eye of God the slave is equal to his master*—as the Asiastic, the African and the Indian are alike equal to the European.

"On the other hand, the great men of the earth have, by their wars, commingled the various races of the world, and left behind them some of those imperishable monuments, which, in levelling mountains, opening forests, canalizing rivers, have a tendency to upset those obstacles which divide mankind, and to unite men in communities, communities in people, people in nations. War and commerce have civilized the world. The time for war has gone by; commerce alone pushes its conquests. Let us then open to it a new route; let us approximate the people of Oceanica and Australia to Europe; and let us make them partakers of the blessings of Christianity and civilization."

It would not fall within the scope of the present address, which seeks to review the men and the sovereigns of the last fifty years, not as potentialities, but as historical facts, with actual, visible results, to look beyond the present hour, or to enquire how far the reigning Emperor of France will probably carry into practical effect the enlightened and far-seeing views of the "Prisoner of Ham." They now apply not alone to Nicaragua, but emphatically to Mexico, as furnishing a more accessible and easier route for the great interoceanic channel which he then regarded as vouchsafing such blessings to all mankind, and especially to the colored races held in slavery.

Louis Napoleon is a thoughtful student of history, and, as such, wisely covetous of lasting fame. After announcing his purposes,

so grandly Christian and philanthropic—and in full view, moreover, of the magnificent example hung high in the heavens by his great compeer in Russia, emancipating at a single stroke a population of more than twenty millions—can it be possible that he will so disregard the judgment of coming ages as to lend his aid at this late hour to blacken the American continent with the blight of African bondage ; still less that he will openly uphold and abet the unholy and savage effort to establish on the ruins of our young republic a barbarian power proclaiming slavery as its corner-stone ?

Louis Napoleon is, moreover, a mathematician, profoundly versed in the knowledge of quantities, material and political. Will he forget the material and political science practically taught by the first Napoleon in ceding to the American republic nearly one-half of its widespread continental area, for the very purpose of building up in this western hemisphere a continental power of sufficient weight to preserve the political equilibrium of the globe, which the constantly increasing possessions of England were disturbing ?

DISCUSSION UPON THE PROPOSED INTEROCEANIC SHIP CANAL.

Special Meeting, Monday evening, December 15, 1879, at No. 11 West 29th Street, Chief Justice C. P. Daly presiding.

Present,—Gen. Geo. W. Cullum, U.S.A.; Gen. Q. A. Gillmore, U.S.A.; Signor de Franco; Horatio Seymour, State Engineer of New York, and James T. Gardner, Director of the State Survey; Major Sidney F. Shelbourne; Col. T. Bailey Myers; F. A. P. Barnard, President of Columbia College; Messrs. A. G. Menocal, Wm. H. Webb, A. L. Ford, A. J. Cotheal, Wm. L. Elseffer, Elial F. Hall, Wm. H. H. Moore, Cyrus Butler, D. Torrey, John Bogart, Secretary of the Society of Civil Engineers, and others.

Chief Justice Daly: It was suggested, at the last meeting of the Society at which this subject was considered, that it should be continued at the rooms of the Society. The fact that several gentlemen who are familiar with the matter are now in the city, and are about to leave in a day or two, made it necessary that we should call a meeting within so short a period as left no possibility of sending individual notices to our members, as is our custom. All we could do was to give notice in the evening papers to-day, and I am gratified to see that there is a larger attendance than we had reason to expect. We have here present several gentlemen who have made this subject of an interoceanic ship canal a matter of especial study, and their views upon it are necessarily of importance. I will ask Mr. A. G. Menocal, Civil Engineer, who is present, and who is to be in the city but a day or two, to give us his views as to the proper canal to be constructed, and some account, if he will do so, of the Nicaragua route, of which he made the survey.

Responding, Mr. Menocal opened the discussion of the evening by the following remarks :

It will not be necessary, I suppose, for me to enter into any description of the state of Nicaragua, which doubtless is well known to all here. The Lake of Nicaragua, which is at the summit of the proposed canal by the so-called Nicaragua route, is a body of water 110 miles in length, by 30 miles of average width,

having a superficial area of 2,700 square miles. Its elevation above the sea at high tide is 103 feet, and at mean tide 107 feet. The depth, from a point 1,200 feet east of its west side to within about nine miles of its outlet, the San Juan river, is at all points as much as 30 feet, and in some places as much as 150 feet. Several lines were run from the lake to the Pacific ocean to find the lowest depressions in the supervening mountains, and two were found that seemed to offer the best prospects ; in one of these the point of greatest elevation above the level of the lake was 43 feet, and on the other it was 134 feet. The length of the former is 18½ miles, of the latter 16¼ miles. The latter, the shortest, was recommended, for the reason that though the summit was higher, there is on the other line a small stream, or river, carrying 5,000 cubic feet of water per second, that would have to be received into the canal. The level of the lake is to be extended westward eight miles to the slope down to the Pacific. From that point to the sea the ground falls at the rate of nine feet to the mile. The locks are to be so disposed that there will be no less than 2,500 feet between any two of them. A ten-foot lift was adopted, not because the foundations were not firm enough to give a larger, but because this was found about the mean lift of all the locks then in operation in the United States, and was deemed sufficient. Possibly, on the final location of the line, a larger lift might be adopted, and the number of locks reduced. This total lift of 103 feet will be overcome by ten locks. There will also be a tide-lock, to overcome the tide of the Pacific, which at the maximum is 8½ feet, with the medium 5½ feet. The level of the canal there is such that vessels can come in at any time from that side without double lockage. That is, we do not need to have a second system of locks, as would have to be adopted in a canal opening from the east at a lower level than that of the sea. The exploration of this line was extremely careful. In some places elevations were taken every 25 feet, and borings were made every 1,000 feet, particularly on the sites of the locks, to ascertain what foundation we could depend on for the construction of the locks. All the small streams that would cross the line of the canal are to be provided for by culverts, through which their water would be discharged into the Rio Grande, the stream running through the gap along the line of which the canal was located ; and so perfect is the system of drainage afforded by that river, that the water

from any part of the canal can be turned into it, and the desired lock be left perfectly dry. The proposed width of the canal is generally 72 feet, and the slopes of rock are ¼ to 1 above the surface, and ⅛ to 1 below the surface. In earth, the slopes are 1½ to 1. I have merely given this general description upon such points as have suggested themselves to me, and will be glad to answer any questions that any of the gentlemen present may desire to ask me, before we proceed to the description of the canal on the other side of the lake.

Q. by Mr. GARDNER: What is proposed as the actual width of that part of the canal, surface and bottom?

Mr. MENOCAL: The width varies. In this deep cutting of rock it will be 60 feet at the bottom, 90 feet wide 10 feet above the bottom, and 106 feet wide at the surface. In earth, the bottom width will be 72 feet, and the surface 150.

Q. Is there any tunnel from the lake?

Mr. MENOCAL: No, sir; the elevations are not sufficient between the lake and the ocean to require a tunnel, being only 43 feet on one line, and 134 feet on the other.

Q. The depth of the water, I presume, is 24 feet?

Mr. MENOCAL: No; 26 feet in depth on the whole line of the canal. On the west side, where the canal will leave the lake, there will be an excavation, under water, for 1,200 feet, commencing with zero, and extending into the lock at that depth of 26 feet. That will be as far as we have been able to learn from the indications in gravel and rock.

Q. What is the nature of the rock?

Mr. MENOCAL: Trap rock, the same as we find all along the line; basalt and greenstone. That is, it is the rock generally found, though in some places there is limestone. There is a large bed of limestone at this point, La Flor, between the summit and the Pacific.

Q. Will any of the mountain streams be taken into the canal?

Mr. MENOCAL: No; it is not proposed that any of those streams shall be taken into the canal, but that it shall be fed exclusively from the lake. For that reason the higher elevation was adopted, on account of the better drainage. It is, however, proposed now to make further examinations toward ascertaining the possibility of diverting the Rio Grande into the lake; in which case, the line of the lowest elevation will be recommended as the best for the con-

struction of the canal, as it would save no less than six millions of dollars in the estimates.

Q. Where do you get water for your summit level on that line?

Mr. MENOCAL: From the lake. Its level is extended clear to the slope down to the Pacific. It is the summit, and there is no doubt about the supply of water being ample. In the stated area of the lake is, of course, comprised the area of the other and smaller lake, Managua. The present connection between them is only open when they are full, and the water from this lake does not at all times flow into Lake Nicaragua, but that is a matter easily remedied, and the area of the water-shed properly embraces the water-shed of that lake.

Q. by Gen. GILLMORE: What is the greatest rise and fall of that lake?

Mr. MENOCAL: Four and a half feet seemed to be the maximum. We examined well the water-marks, and from all the indications they afforded, we arrived at the conclusion that that was the maximum.

Q. What is the annual rain-fall there?

Mr. MENOCAL: It varies from 45 to 50 inches. For six months we have hardly a drop of rain. In the rainy season we have frequent showers at night, rains occasionally in the day-time, and sometimes there are rain-storms that last two or three days.

Q. What is the size of the locks you contemplate?

Mr. MENOCAL: The locks proposed are 400 feet long, by 70 feet wide; but that length may be increased to 450 or 500 feet if it is deemed desirable. There are, however, few vessels now afloat that will require above 400 feet, and I suppose that will answer for all practical purposes.

Q. Are there many mountain torrents to bring in debris?

Mr. MENOCAL: No, sir.; not into the canal, which is kept entirely free from surface drainage.

Q. What kind of a harbor have you at Brito?

Mr. MENOCAL: A very small and insufficient one. We will have to build a harbor there.

If there are no more questions to be asked about this portion of the work, I will now pass on to the consideration of that part of the canal on the other side of the lake. The San Juan river is the outlet of Lake Nicaragua, and carries off, when the lake is full, from 12,000 to 15,000 cubic feet of water per second. The river falls

but two feet in 28 miles, and then 12 feet in the following nine. There are two rivers emptying into the lake—Rio Rama and Rio Frio—almost parallel with the San Juan, but running in the opposite direction, both of which are large streams.

You will perceive that the water-shed of the river, between the lake and where we leave it, is very small. The depth of the stream will have to be increased, by dredging and blasting under water, to a mean of six feet. The maximum will be at Toro rapids. The fall of the river to those rapids is two feet only, and at the rapids we have a fall of six feet from there to Castillo, where we propose to build the first dam. This dam is proposed to be 940 feet long. The rise of the water will be 18.87 feet in front, and 13.32 below, by the second dam. The second dam will be 1,196 feet in length, and 31 feet high above the bottom of the river. The rise of the water here will be 22 feet above and 12 feet below. The third dam will be 824 feet in length, and 33 feet, or nearly 34 feet above the bottom ; the rise in front 26 feet, and below 16 feet. The last dam will be 1,000 feet in length, and the water will be raised in front 30 feet, the fall 23 feet. In the other dams, the fall will be equal to the lock in the short canal that is going to be built around the dam, which in every case is ten feet and a fraction—ten feet and nearly ten inches. Below Toro rapids, there will be no dredging of the river, because the present depth of the river, increased as it will be by the raising of the water by the dams, will be sufficient, except in two places, to give the required 26 feet. Between the last two dams the river is very deep, as much as 80 feet, which would bring the bottom 30 feet below the level of the ocean.

At this point the Rio San Carlos comes into the San Juan. This is a silt-bearing river, a torrential river, and for that reason the canal is there taken from the line of the San Juan and is built inland. Owing to this high hill right opposite the mouth of the Rio San Carlos, it is proposed to extend the slack-water navigation to a few hundred feet below the mouth of that river, where the last dam will be constructed, and a new channel is proposed for the Rio San Carlos, to divert it and make it empty into the Rio San Juan below the dam, so as to preserve for the canal only the clear water from the lake.

These short canals around the dams are to be about a mile in

length; one is to be three-quarters of a mile, and the others between that and a mile and a quarter. The dimensions of these sections, or small canals, are to be similar to those of the one proposed on the other side of the lake. Now we come to the consideration of the section between where the canal leaves the river and Greytown.

Q. by Gen. GILLMORE: What is the extreme length of this slack-water navigation?

Mr. MENOCAL: Sixty-three miles, with four dams.

Q. by Mr. GARDNER: How far from the lake to the first dam?

Mr. MENOCAL: Thirty-seven miles; so that really the level of the lake will extend on the Pacific side eight miles to the slope, and 37 miles on this side.

Q. What is the discharge of the San Juan?

Mr. MENOCAL: It varies. Above this point (indicating on the map) at a high rate from 12,000 to 15,000 cubic feet per second; below this point, sometimes 22,000 to 24,000, because the volume is increased by this large river, the San Carlos, and others. Besides the San Carlos, as you will see, we have three other rivers coming into the San Juan, below where the canal leaves it. The larger tributaries all come from the Costa Rica side. The largest are the San Carlos and the Serapiqui.

Q. Then from where you enter the lake on the west side there is unimpeded navigation for 93 miles?

Mr. MENOCAL: Fifty-six and a half, lake—37, river—all at the same level—and eight on the other side; so that really the navigation is uninterrupted for 102 miles of summit level, 103 feet above high tide.

Q. What is the extreme rise and fall of the slack water of the San Juan in times of flood and drought?

Mr. MENOCAL: The maximum rise is between four and a half and five feet. The lake acts as a large distributing reservoir, so that the floods have little effect on the rise and fall of the river.

Q. What is the average breadth of the river?

Mr. MENOCAL: At the broadest point, between the last two dams, it may be, in some places, only about 600 feet. That is where it has such very great depth. Above the third dam there is an average of 1,200 feet, except in one place, where it contracts to 840 feet. That is at Machuca. Above that it is all from 1,200 to 1,500 feet wide.

Q. What is the depth, or what will be the depth, when the improvements are completed?

Mr. Menocal: 26 feet.

Q. And the width at bottom?

Mr. Menocal: 80 feet, with slopes of 6 to 1 where dredging is required. For a vessel drawing 20 feet the channel width there would be 152 feet, and for one drawing 24 feet would be 104 feet. I do not see, really, why the width of this canal should be any larger than the one on the other side, because there are no winds to be feared, because the river is protected by the high hills and forests on the sides, and the current is not over half a mile per hour. The prevailing breezes are from the northeast. Here, in the lower canal, where the line of the dredging to the dimensions indicated extends, the mountains and forests so shield a vessel that there is but a very light breeze. It is so also on the river, and there is no fear of winds throwing the ship from one side to the other of the canal.

Q. What water will you have on the dams?

Mr. Menocal: I have computed very closely the water at the top of the dams at both high and low water. The thickness of the volume of water on the first dam will be 2.93 feet, on the second 2.56 feet, on the third 3.28 feet, and on the last 2.92 feet. The velocity of the water in the river will be, in the first section, .46; in the second and third, .54; and in the fourth, .49; so in only two sections will the velocity of the current be a fraction over half a mile per hour. The flow of the river is, in the first three dams, as near as we could come to it, 12,453 cubic feet per second in the first, and 12,953 cubic feet per second in the second and third; while in the fourth it is 13,206 cubic feet per second. So the difference in the volume between the first and last reach of the canal in that slack-water navigation will be only about 800 cubic feet per second, which is caused by the small streams coming in between the lake and the Rio San Carlos.

Q. Is that at low or at high water?

Mr. Menocal: At low water—I have it also for high water, but fail to find it in the notes I have with me. But I know positively, without having the data to confirm my memory, that at no time will the water on the top of the dam be over four feet in thickness at high water. As you see, it is only the last dam that will have to stand the pressure of the water raised in front. Borings were

made at the sides of the river where the locks are to be located, and the character of the rock was found to be the same as on the other side of the lake—that is, wherever rock was found; but we saw very little rock on this side of the lake, only in the bottom of the stream, in reefs, here and there, and in the rapids already spoken of. Here, in the rapids, we did not take any borings in the bottom of the river, but when the lead struck hard bottom we estimated it rock, and where it went through soft material we estimated earth or clay.

Q. What harbor is there on the Atlantic side?

Mr. MENOCAL: There is no harbor. One will have to be made. I am coming to that directly. We are now arrived at the section between where the canal leaves the river and Greytown. It follows the line of the river to this point, as you see on this map, a distance of 24 miles, and thence goes by almost a straight line to Greytown. The line was at first laid out here, along and over these hills, but afterwards I made a complete survey of that part of the country and found a lower path, by which the line can be located at a reduction on the former estimates for cutting, of from one and a half to two millions dollars.

Q. What is the estimated total cost of the work?

Mr. MENOCAL: Fifty-two millions, to which is to be added the customary allowance of 25 per cent. for contingencies—call it, altogether, including the harbor improvements necessary, $65,000,000. The harbor at Brito will cost $2,337,000; that at Greytown, $2,822,000. The cost of harbor improvements, such as will be here required, will be not great, for the reason that we will have abundance of rough stone, convenient of access, from the excavation of the canal, and plenty of excellent wood near at hand.

Q. What is the rise of the tide on the Atlantic side?

Mr. MENOCAL: One and a half feet.

Q. What drainage have you on this side?

Mr. MENOCAL: It varies, but is always amply sufficient (because the river is), though constantly following the canal, at varying distances from it. The bottom of the canal is, however, generally, above the bottom of the river, and the streams coming from the north it is proposed to pass under the canal by means of siphons, except some very small ones that may be received into the canal.

Q. What is your project for the harbor on the Atlantic?

Mr. Menocal: We propose to build a jetty. At Greytown the sea strikes the sand beach at an angle of about 45 degrees, and is constantly shifting the sand from east to west. This has caused the formation of the sand bar now closing the harbor. It is proposed to build a jetty out to a depth of 30 feet at low tide, and let these drifting sands from the northeast accumulate in the angle between the coast and the jetty. In course of time it will fill up there, but then, by a further extension of the jetty two or three hundred feet, we would increase to almost double the area of deposit, and the harbor would be preserved from the shifting sands for a certain number of years. The artificial beach thus formed by the accumulation of the sand may be so shaped that it will be either perpendicular to the prevailing winds, or so inclined to them that the sand, instead of moving toward the entrance of the harbor, will be shifted to the south toward the Colorado, when the harbor may be considered permanently restored. The Colorado river takes $\frac{29}{30}$ths of the water of the Rio San Juan, only $\frac{1}{30}$th going to the harbor of Greytown. It is proposed in the plan for the improvement of the harbor so to obstruct the channel of the lower San Juan, by means of trees and other obstructions, as to throw all the silt-bearing water of the San Juan into the Colorado, and receive into the harbor only the clean water of the canal, drawn from Lake Nicaragua. I have here plans showing the alterations in the harbor of Greytown from 1809 to the present time, and, if you will look at them, you will see at once that the bar has been formed in the way I have described.

Q. Is the mouth of the San Juan river permanent in its location, or has it moved?

Mr. Menocal: Well, it is permanent now, so far as its emptying into the lagoon is concerned. It does not empty into the ocean, but into the lagoon. In the wet season, when the accumulated waters bank up in the lagoon, then it cuts an outlet through the sand-bank to the sea, but as soon as that pressure is removed that outlet is quickly closed again by the sands drifted by the action of the wind.

Q. What is your estimate for the removal of earth from the canal per cubic yard?

Mr. Menocal: Thirty-five and forty cents per cubic yard.

Q. And how much for rock?

Mr. Menocal: \$1.25 and \$1.50, and under water \$5. The

blasting and dredging of rock under water will be done in the Rio San Juan before the water is raised by the dams. I think, however, that if it be desired, the dams can be built at the same time the dredging and blasting is going on, by leaving sluices sufficiently large to carry the volume of the river. After all the dams are completed, these sluices—which will be provided with gates—can be closed at once, and then, as the water has to be banked up to the lake, I calculate that it will take about four months before the water comes to the top of the first dam. During that time the sluices and openings will be closed with masonry, and, before the full pressure comes upon them, will have ample time to settle.

Q. What is the material you will employ in the locks and dams?

Mr. MENOCAL: Concrete. It is difficult in that country to find dimension stone. The country rock will make a nice material for concrete work, but it would not do for cutting into dimension stone.

Q. What is the lowest temperature there in winter?

Mr. MENOCAL: About 71°, and in summer it rises to 81°. The variation is only about ten degrees in the year.

Q. Have you examined the old structures on the Isthmus, between the lake and the Pacific, to see if they are cracked by earthquakes?

Mr. MENOCAL: Yes; and they are not at all affected from that cause. They cannot have been injured and repaired, for they are entirely neglected by the Indians; yet they are in as good condition as they were, presumably, when the Spaniards left them.

Q. Do you anticipate any danger to the locks of the canal from the action of earthquakes?

Mr. MENOCAL: Decidedly, I do not. I do not know that earthquakes there ever do any damage to life or property, or that they ever have the slightest effect of altering the water supply in rivers, lakes or wells. But even if the wall of a lock should be cracked, it will be a very simple thing, and readily executed, to repair it.

Q. Are there, properly, less apprehensions of danger from earthquakes there than in other parts of the Isthmus?

Mr. MENOCAL: Not less than in all other parts, but much less than in some others. For instance, in San Salvador they are much more violent and frequent, and in Guatemala and in parts of the United States of Colombia.

Q. Have you examined the ruins left by Walker at Grenada, to note their condition, as to whether they had been affected by earthquakes or not?

Mr. Menocal: I have. They stand to-day just as he left them; those, at least, which were allowed to remain as ruins. The houses were rebuilt, but the churches were not, and their bare blackened walls, standing alone and devoid of any support or braces, rise to a height of, I should say, forty feet. I have examined them very carefully, and did not find a crack in them. Some of the towers were partially blown down then by powder, and look as if they were likely to tumble down at any moment. One, especially, seems threatening to fall with the wind. Yet they stand there as they have stood since 1854. Those are forty-two miles from the line of our proposed canal. In the town of Rivas—two and a half miles from the canal—they have many stone houses, and about ten years ago they completed a stone church there, which had been building during thirty or forty years—one which would be a noteworthy stone church anywhere—and it has never received any injury from earthquake shocks, nor have the stone houses about it.

Q. Those Spanish ruins at Grenada, Castillo and San Carlos must be over one hundred years old?

Mr. Menocal: Not less than three hundred years, probably, some of them. I had occasion to show to the United States commissioners dams that had been built surely over one hundred years ago, which are standing to-day, though not for any present practical purpose, which have never been repaired, yet which manifest no imperfections which can be detected by the closest examination. They were built originally for the purpose of damming up water to be used in the manufacture of indigo, and were abandoned, and have been standing there for one hundred years, perhaps. We saw a gentleman who lived close to the dam near Rivas, and he said it had been there since he was born—he was not less than seventy years old—and before his time, but he could not say how long, as his father never told him when it was built. Yet it is now in the same perfect condition that it was, presumably, when first built, with no cracking, no imperfections and no leakage. Yet it has no apron, and the water has a sheer fall of 15 or 20 feet to its base. Its length is 75 feet. That shows, to my mind, not only that earthquakes there will do no injury to constructions of this character—the locks of our canal, for instance—but that the material we have there for the construction of the work is of the best quality.

Q. What material did you say you proposed to use for locks?

Mr. Menocal: Concrete; and I suppose the lime of the country would be sufficient.

Q. What sort of wood have you?

Mr. Menocal: Oh, excellent—of various kinds, with Spanish names that I do not recall at this moment.

Q. Are those old Spanish works of concrete?

Mr. Menocal: Rubble masonry, with mortar between; the spaces among the large rough stones filled in with smaller ones and mortar.

Q. by Gen. Gillmore: At what do you estimate the cost, per cubic yard, of this construction?

Mr. Menocal: From $7.50 to $9 per cubic yard for the locks, and $12 per cubic yard for the dams, on an average. To be explicit, take lock No. 2 as an example: concrete and foundation, $7; lock walls, $8; lift walls, $8; rubble masonry, $7.50 per cubic yard. For the dams across the San Juan the estimates are: rock excavation, $5; hydraulic concrete, $12; rubble masonry, $15; concreting abutments, $8; coping (dressed stone), $20, per cubic yard.

Q. You can get all the materials there at hand?

Mr. Menocal: All the materials. The excavations of the canal will furnish the stone, and the lime of the country will answer every purpose. They have built a small water-works at Masaya, in Nicaragua, which lifts the water 224 feet; and they have constructed a reservoir or tank in the centre of the town, where they store the water to a depth of 20 feet. The thickness of the wall of this tank at the bottom is only 4½ feet, hardly the theoretical thickness required for the best possible construction of such a wall, yet this is built only in the roughest way, of rubble work, and though it has been in use four or five years, there is not the slightest sign of any imperfection from weakness, earthquakes or any other cause.

Q. How about the harbor on the Pacific side?

Mr. Menocal: On the Pacific side, we propose to build a jetty here (indicating on the map), starting from this point, 800 feet in length, extending out to 25 feet depth of water; and another jetty here, running westward, to prevent the sand shifting into the harbor. Then the harbor will have to be dredged. No rocks will be encountered there. I have tested to a depth of 30 feet under water and found the bottom all sand. The materials for the

jetties will be taken from this hill, on the coast, which is nothing but trap-rock.

After these surveys were completed, the government ordered a commission of two army officers, an assistant to the coast survey, and two civil engineers, to go over the line and verify the work. The line was located only two years before, so that the stakes and bench-marks marking the locks, cross-sections for dams, etc., were still preserved and were carefully examined by them. Also, through our suggestion, several portions of the line were carefully re-surveyed by them to determine the accuracy of the surveys which had been made. All were found to be perfectly accurate in every point. Bench-marks were found about every 2,000 feet along the line, and the profiles were found to be the actual facts in the careful surveys we had made. After they were made, I was in the country several times, in connection with the improvement of the Rio San Juan and harbor of Greytown, and also with reference to a proposed improvement connecting the two lakes—Nicaragua and Managua. Then I made still further careful surveys of this portion of the line, and I know that modifications of the original survey can be made that will reduce the cost of the canal perhaps ten or fifteen per cent. I am sure that any change made in the line, in accordance with my suggestions, will tend to reduce the estimates.

Q. In what year were the estimates made?

Mr. Menocal: In 1872.

Q. What was Mr. Child's estimate?

Mr. Menocal: His estimate was for a canal only 16 feet in depth, and I think it was $34,000,000. Perhaps it was only seventeen or eighteen millions; I do not remember now.

Q. What is the radius of your shortest curves?

Mr. Menocal: 2,200 feet. That is the minimum adopted, and was recommended by naval officers whom I consulted on the subject. They said that the versine of an arc with a chord of 500 feet in such a curve being only 4 feet, there would be no difficulty in taking a ship 400 feet in length around a curve of that radius. An enlargement of the radii of all curves to 5,000 feet would not increase the estimates more than one and a half or two millions of dollars.

Q. Did you see any external indications of earthquakes along the line of the canal?

Mr. Menocal: None whatever, sir; and I would like to call upon Mr. Ford, an expert engineer who is conversant with that country, to say what is his information upon this subject of earthquakes.

Mr. A. L. Ford: It is commonly said there, and reported in the authorized government history of the country, that there has been no instance of loss of life or property by earthquakes.

Q. by Mr. Menocal: You went through Leon?

Mr. Ford: Yes; and I saw no marks or imperfections caused by earthquakes. I also examined with interest some very large concrete-walled tanks—indigo vats—that have been built several hundred years, but show no signs of cracking.

Q. by Chief Justice Daly: Does this apply to the whole country?

Mr. Ford: It is so said. I do not know of my own knowledge, as I did not go through the whole country.

Q. by Chief Justice Daly to Mr. Menocal: What are the most prominent engineering objections to the Panama route?

Mr. Menocal: I suppose the Chagres river offers the most really serious one, and the rise and fall of the Pacific tide and the prevailing calms at Panama the next. The Rio Chagres, in the dry season, is a very small stream, say 250 feet wide and two feet deep. I have waded across it many times. But in the rainy season it becomes a torrent and rises in less than a single day to a maximum of 40 feet. In that case the width of the river is some 1,500 feet, and the volume of water carried fully 160,000 cubic feet per second. The bed of the river is 42 feet above the sea, and as it rises 40 feet in flood at the point where it is proposed to be taken into the canal, you see it will have to be received into the canal with a fall of 82 feet, or say 78 feet, making allowance for the decrease due to the velocity of the water as it approached the precipice, and for the head of water above the ocean level after falling.

Q. Does not the Chagres river bring down much debris?

Mr. Menocal: Oh, yes; very much—decayed vegetation, mud, trunks of trees, houses even. In the recent floods it carried away two whole villages. I see reports that it even carried away an iron tank that was 17 feet above the level of the Panama railroad track.

Q. What is the rock formation there—on that route?

Mr. Menocal: Sandstone, conglomerate, limestone, coral, and in the upper Chagres large masses of a very soft limestone, so soft

that with a half-pound hammer you could break off large pieces of it. And it is not a continuous mass. On one side of the river you will see a vertical, or even overhanging, limestone wall, 80 feet high, and on the other side of the river four or five feet only of limestone, with 20 feet of clay on the top of it; and in a few feet farther you will find the limestone wall on the other side of the river where the clay was, and the clay on the side where the limestone was.

Q. How does M. de Lesseps propose to deal with it?

Mr. MENOCAL: At the Paris Congress they proposed to build an artificial channel from where they intend to take the river-bed for the canal to the sea.

Q. How far is that?

Mr. MENOCAL: It is 30 miles by railroad; I do not know how far by their canal. They will have to cut through some very high hills and mountain spurs projecting on both sides of the river to its very banks, in order to straighten its tortuous course to meet the practical requirements of a ship canal; and they will have to build walls across the lower valleys between the high hills extending to the river. As the cross-section of the river is 15,000 square feet, and the water-section they propose to give the canal is about 2,000 square feet, the new channel for the river will have to be no less than $7\frac{1}{2}$ times the proposed section of the canal.

Q. Do you think the enormous waterfall there would have any effect upon a marine railway?

Mr. MENOCAL: I think it would, as has been proved by the great damage done to the Panama railroad by the recent floods of the Chagres river.

Q. The canal, then, would have to discharge 160,000 cubic feet of water per second in time of flood?

Mr. MENOCAL: Of course, since it is to receive the volume of the river; and what difficulties may have to be encountered in confining so great a body of water, moving with such velocity, in an artificial channel, we may well appreciate, since we all know how hard it is to divert even small streams and confine them to new channels.

Q. And the velocity is very great?

Mr. MENOCAL: No less than seven miles per hour with the present fall of the river, and as the canal is only a few hundred feet from the river, and the water of the river is several feet above that in the

canal, we may well fear that at any time the river may overflow its artificial banks and flood the canal.

Q. by Chief Justice DALY: Will you not explain a little more fully the difficulties to be encountered at the mouth of the canal—I mean of the Panama route—and the means by which the projectors of that route propose to overcome them?

Mr. MENOCAL: I do not know what plans they propose to adopt.

Q. You suggested a difficulty from the character of the coast?

Mr. MENOCAL: If they build their canal at the level of the sea at Panama, they will have to excavate in the Bay of Panama one and a half miles under water, and in the harbor of Colon they must also excavate under water a long distance to get sufficient depth for their canal.

Q. And they will require steam vessels to get sailing vessels out of the Bay of Panama, will they not?

Mr. MENOCAL: In regard to that, I will request Col. Myers to read a paper I have here--a letter from Commodore Maury—with some remarks thereupon by Captain Pim, of the Royal Navy.

Col. T. BAILEY MYERS read the following:

"30 HARLEY ST., CAVENDISH SQUARE,
"LONDON, July, 1866.

"MY DEAR CAPTAIN PIM,—I had occasion some years ago to study, more or less closely, almost every route between the British possessions on the north, and the Isthmus of Darien on the south, whether rail or canal, that had up to that time been attempted or projected across the American continent. Owing to the character of the researches with which I have been for more than twenty years engaged, my attention was directed to those routes rather in their physical and commercial aspects, than to their topographical features, or to their facilities of construction.

"The great importance of one or more *good* commercial highways across Central America being admitted, the whole question as to route resolves itself pretty much into a question of the cost of construction, and the facility of ingress and egress by sea to and from the opposite termini; the latter is an affair of winds and currents. Their influence is powerful. Panama has the advantage of land transit; Nicaragua has the advantage in winds, terminal ports and climate. The first is obvious; but to place the latter in a clear

light, a little explanation may be necessary. * * * I have spoken of a calm-belt about the equator; Panama is within its range. Owing to the contour of the Central American isthmus, the height and direction of the mountain ranges by which it is traversed, and the influence of these upon winds, this calm-belt is greatly enlarged on the Pacific or lee side of the isthmus. It is difficult to convey, to one who has never experienced these calms, an idea of the obstinacy with which they vex navigation. We are all familiar with calms at sea, which last for a few hours, or even a day; but here they last for days and weeks at a time. I have known vessels going to or from Panama to be detained by them for months at a time. * * * On one occasion the British Admiralty, wishing to send one of their sailing vessels into the Arctic ocean from Panama in time to save the season, had her towed by a steamer through this calm-belt, and carried 700 miles out to sea before she could find a breeze. * * * These remarks apply to the approach and departure by sea to or from the Pacific terminus of any route across the Isthmus of Panama or Darien, and even with greater force to the Atrato and others on the South American side of Panama. In short, the results of my investigation into the winds and currents of the sea, and their influence upon the routes of commerce, authorize the opinion which I have expressed before, and which I here repeat, namely: if nature, by one of her convulsions, should rend the continent of America in twain, and make a channel across the Isthmus of Panama or Darien, as deep, and as wide, and as free as the Straits of Dover, it would never become a commercial thoroughfare for sailing vessels, saving the outward bound, and those that could reach it with leading winds. Steamers would and coasters might use it, but homeward-bound vessels in the China, India or Australia trade rarely. * * * We come now to the Nicaragua routes. Of these there are several. Though longer across from ocean to ocean than Panama, some of them have already, and with a degree of success by no means discouraging, competed with it before the world for public favors. * * * Skillful engineers, both French and American, have examined them [the engineering difficulties and topographical features of this Nicaragua route]. Those of both nations report gradients gentle enough for a canal. In truth, the lakes, their distance from the sea, and their height above it, indicate that the summit-level is to be attained without any very steep ascents.

"It is to this part of the isthmus, too, to which we must look for a route which shall best fullfil the present requirements of commerce between the two oceans, as well as for transportation and travel between the Pacific shores of North America on the one hand, and the Atlantic shores both of Europe and America on the other. * * * Vessels under canvas would, in the main, do the fetching and carrying for the Nicaragua route, which, for reasons already stated, cannot be done for Panama. The aggregate amount of this trade is immense, and it is neither accommodated for Panama, nor Panama for it. * * * Therefore, returning again to the physical features of the Panama route, as I promised to do, we can now compare more in detail than I have yet done the advantages possessed by each, as far as those advantages are influenced by facilities of navigation, by the elements, by salubrity of climate, and by the dictates of commerce. The French and English Admiralty charts give the most accurate information that I possess concerning the harbors at the opposite ends of the two routes, Panama and Nicaragua—I mean as to mere anchoring ground, depth of water, and shelter afforded. It is proper to remark here, that I was a great friend, an earnest advocate, and an active supporter of the Panama road, giving it in 1849 the preference over all other isthmian routes. At that time my 'wind and current' investigations had not extended into the Pacific ocean, and the discovery of those causes which make the approach and departure to and from the Bay of Panama so very difficult for sailing vessels had not been sufficiently established to give them their proper weight. * * * You will observe, at a glance, that the Isthmus of Panama, or Darien, is, on account of these winds and calms, in a purely commercial point of view, the most out-of-the-way place of any part of the Pacific coast of intertropical America. * * * 'Lieutenant Maury,' remarks Mr. Hull, master of H. M. S. *Havannah*, 'truly says that the passage under canvas from Panama to California is one of the most tedious, uncertain, and vexatious that is known to navigators.' Realejo (Nicaragua) is in the northern verge of these calms (Panama), and where they have nearly ceased to be vexatious to the navigator any season. Here, then, is the physical advantage in favor of the Nicaraguan route, for which it is difficult to find the money value. * * * The transit route of Nicaragua is exempt from those heavy drawbacks of dampness and disease. It passes through a salubrious

climate. The soil is productive ; its pastures abound in cattle. I never heard of any disease peculiar to the country, or of especial virulence there.

[Signed] "M. F. Maury."

Col. Myers : Upon the foregoing letter, Captain Pim goes on to remark, in a paper read by him before the British Association in Sheffield, this year, as follows :

"Commodore Maury tells us in the plainest language, that if nature, by one of her convulsions, should rend the continent of America in twain, and make a channel across the Isthmus of Panama, or Darien, as deep, and as wide, and as free as the Straits of Dover, it would never become a commercial thoroughfare for sailing vessels, and I have only to endorse this opinion; for of all parts of the world I have ever visited the calms in the Bay of Panama are the most vexatious and enduring. It therefore seems the clear duty of a Central American Isthmus canal projector to decidedly avoid this locality. Under these circumstances it becomes necessary to look elsewhere for a more feasible line of transit, and (once more relying upon the letter of Commodore Maury) the route from the Atlantic by way of the magnificent Nicaraguan lakes to the harbor of Realejo, seems that which is adapted for the required purpose ; for, as Commodore Maury states, and I quite agree with him, it would be impossible to exaggerate the money value of having, as he describes it, a fair start and approach by means of the little monsoons of that coast.

"Assuming that arrangements can be made for transferring the public favor—or perhaps I ought to say that of M. de Lesseps—from Panama to Nicaragua, I think it may be desirable, as I have been many, many times over that route, to give a general outline of its features, and I will conclude by offering a few suggestions, which I trust may prove of utility to those who will embark in the grand enterprise of effecting a junction between the Atlantic and Pacific oceans. The great difficulty to be overcome in the construction of a canal across Nicaragua is in the making and maintaining the harbor of Greytown on its Atlantic terminus. My friend, the late Mr. Robert Stephenson, the great engineer, when I was with him in Egypt in 1858, used to say that he was acquainted with the deltas of all the great rivers of the world, but that he was

not aware of a single instance in which a harbor was maintained at the mouth of such rivers. Now, the Rio San Juan de Nicaragua has a delta at its mouth, but no other delta in the world is so capricious. In 1856 a squadron of Her Majesty's ships rode securely at anchor in the harbor of Greytown; but in 1860, when I was stationed as senior naval officer in that locality, the sand-bar which made the harbor stretched across very nearly from shore to shore, leaving only sufficient depth of water for the very smallest coasting craft. A few years later there was again a considerable opening, and so matters go on, but now for some time it has been completely closed. A strong norther is sufficient to close the harbor, while a high river will reopen an entrance. Mr. Robert Stephenson's dictum, therefore, as to the enormous difficulties to be encountered in the attempt to form a harbor at the delta of any great river is more than borne out in the case of Greytown; although I am well aware that an exception has occurred to this ruling in the case of the Mississippi, where Mr. Eads has succeeded in obtaining a depth of 27 feet, under high pressure from Congress; but the problem is, how to *maintain* that depth at anything like a paying cost? If the engineering difficulties could be overcome in forming and maintaining a harbor at Greytown, the other obstacles to the opening of the canal from ocean to ocean would be found of very secondary importance; but to my mind the cost of such an undertaking would completely paralyze the enterprise."

Q. by Major Sidney F. Shelbourne: Can you tell me, sir, whether Captain Pim does not now hold a concession for a canal by way of Nicaragua?

Col. Myers: I cannot, sir. I have simply been requested to read this article, and know nothing farther of Captain Pim's interests in or associations with any interoceanic ship canal enterprise.

Mr. Thos. de Franco: He holds a concession for a railway instead of a canal, I understand.

Major Shelbourne: I hold in my hand an article in which it is stated that there are now three concessions for Nicaragua canal routes—one to M. de Belly, one to Captain Pim, and another the one in which Commodore Vanderbilt was once interested.

Col. Myers: I take it, sir, that it is entirely immaterial to the discussion of the questions at present before us who holds concessions, or is going to furnish the money to build the canal. What

we are endeavoring to arrive at is a knowledge of the feasibility of the several routes, their difficulties and advantages, by such information as Mr. Menocal is now endeavoring to give us from his surveys upon the route he advocates. When we have heard from him we hope to hear from others, until we have collected all the information possible of value for the world. It will then be time to discuss other questions. There have been for years, as we are all aware, many projects, in some cases sustained by official grants for various forms of transit, none of which were carried out, perhaps for want of money. The present discussion has again called attention to them. If any of them are an improvement to those accepted by the French Congress, or approved by the American government, the projectors will have the opportunity of settling their relative merits amongst themselves, and with those who appear to be acting with an assurance of means to build, and therefore must have the privilege in the end of selecting their route. Having no interest myself, present or prospective, in any project, I feel at liberty to express this opinion.

Mr. Menocal: The reason I asked the reading of the letter and accompanying matter was simply for the purpose of placing before the meeting the opinion of so great an authority as Captain Maury.

Q. by Chief Justice Daly: Do the trade winds blow regularly, on both sides of the isthmus, at the termini of the Nicaragua route?

Mr. Menocal: Yes, sir.

Q. And how far down do they extend on the Pacific side?

Mr. Menocal: Not so far as Panama. A sailing vessel generally gets about as far as Costa Rica without difficulty.

Q. And with those trade winds, sailing vessels can at all times approach either the Pacific or the Atlantic end of this canal?

Mr. Menocal: Yes, sir.

Q. It is published that your estimate for passing a vessel through the canal is thirty-eight hours?

Mr. Menocal: Yes, sir; that is correct.

Q. At what rate of speed would that be?

Mr. Menocal: Three miles per hour in the canal, eight in the river and ten in the lake, the usual speed of a steamer at sea. The time allowed for passing through the locks is twenty minutes. There are some gentlemen here who have some experience with

canal locks, from whom I would be glad to hear an opinion as to whether this is an over-estimate or not. Mr. Seymour and General Gillmore can speak as authorities on this subject, I believe.

HORATIO SEYMOUR, Jr.: I do not know that I am particularly posted in this matter, any more than are a number of other engineers here.

Mr. MENOCAL: Only in regard to the time required to pass the locks, I should like to hear your opinion.

Mr. SEYMOUR: I should say twenty minutes for each lock was a proper estimate of time. It takes a boat eleven minutes to go through one of the Erie canal locks. At the Sault S'te Marie it takes twenty minutes. Col. Weitzel estimates twenty minutes as quite sufficient.

Gen. GILLMORE: Twenty minutes is an ample allowance of time.

Q. by Chief Justice DALY: I understand these locks are made for 3,000-ton ships. Can you slow up a 3,000-ton ship, get it through the lock and start it again in twenty minutes?

Mr. MENOCAL: That is what more experienced engineers than myself in canal operation believe is practicable.

Q. Are there any locks in the world, of the same magnitude as these are intended to be, which would afford a precedent as to time?

Mr. MENOCAL: Not except in the enlargement of the Welland canal, which at least approximate. They are 270 feet in length, by 70 in width. Here in the United States I think we have locks 400 feet long, but not so wide or so deep. The Ohio locks, I think, are only twelve or fourteen feet in depth. It is in the handling of the ship, where you have to swing it around, that time is required, and that will be all that will cause delay in the operation of the tide lock—getting it into the axis of the lock. But in a canal where the line of the vessel is in the axis of the canal, all we have to do is to stop the velocity of the ship, close the gates, and then, when the gates before her are opened, the ship starts again, promptly, and without any swinging around. The opening and closing of the locks can be done in a very short time.

Mr. GARDNER: There can hardly be greater difficulties in passing ships through ship canals than are encountered in the St. Lawrence canal, yet nine thousand were passed through there in one year.

Mr. Menocal: And they have there but one system of locks, have they not?

Mr. Gardner: I think most of them are single.

Mr. Menocal: The engineer of the North Sea canal, Mr. Conrad, who is in favor of M. de Lessep's plan, told me they could pass seventeen ships during the hours of the day—they do not operate the locks at night—through the two great locks of the North Sea canal; that is, large ships of four or five thousand tons. If there were that number of ships to pass through our canal, with a system of single locks, we could carry four or five times the probable trade of the canal.

Q. I understood from Lieut. Wyse, in a series of interviews I had with him last winter, that M. de Lesseps was opposed to the lock system, because there was no precedent by which to satisfy owners of vessels that they would be safe in entrusting their vessels and cargoes to such an extensive system of lockage as proposed by the Nicaragua route, or by the plan he himself proposed by way of the Atrato.

Mr. Menocal: It is to be remembered that M. de Lesseps is not an engineer, and never had anything to do with canals until he was a financial promoter. I have here the opinions of M. Cotard and M. Lavalle—two prominent French engineers, who took an active part in the construction of the Suez canal. They find no difficulty in building a canal on the plan proposed by the Nicaragua route, and before the Paris Congress advocated the construction of that canal. M. Lavalle has subsequently stated before the French Society of Civil Engineers that the efficiency of the Suez canal would have been increased if a tide lock had been built on the Port Said side of the canal. Neither of those engineers anticipate any difficulties in working a canal with locks, provided they are properly built and sufficiently supplied with water.

Mr. Gardner exhibited a profile of the Welland canal improvement. He said: This represents a canal 27¼ miles long. You will observe that there is a perfect staircase of locks, to carry vessels of 2,000 tons, and the total lockage, by this staircase, is 326¾ feet, or three times as high as from the Atlantic to the summit-level of the proposed Nicaragua canal. These locks are 240 by 40 feet, with a depth of 14 feet. The total height of the lockage between the lake and Montreal, is about 550 feet. The Cana-

dians built their first ship canals in 1829, and after about twenty years' experience with the system, were so well satisfied that they commenced enlarging and improving them, and they have expended about thirty million dollars in this work of enlarging these canals so as to make them practicable for 2,000-ton vessels. The Canadian engineers have more experience than any others with long ship canals, and demonstrate their success most practically by the enterprise with which they are extending and enlarging their serviceability. The total expenditure of Canada on this long ship-canal route, when it shall have been completed, will be over $54,000,000.

Chief Justice DALY: Within $10,000,000, nearly, of the Nicaragua canal's estimated cost.

Mr. GARDNER: Yes, about the same as the Nicaragua canal proper. But here this lockage, in a single place, within a distance of seven miles, is three times as great as that required on the Nicaragua canal. The locks are not as large as it is proposed those shall be, but they are large enough to carry 2,000-ton vessels, and these vessels succeed each other rapidly, one right after another. Through the old Welland canal they could put through 4,400 vessels in a single year, but through the new system 9,000. I telegraphed yesterday to the Secretary of the Department of Railroads and Canals, at Ottawa, to know the actual time a vessel made in going from Port Colborne to Dalhousie, and he sent me back word that he had transmitted full information by mail—which does us no good this evening. I had hoped to be able to present the information now, but will have to defer it until another time.

Q. How many locks are there in that staircase?

Mr. GARDNER: They have 27 in the flight, of about 12 feet lift.

Major SIDNEY F. SHELBOURNE: It is disagreeable to have to differ from a gentleman of such experience and ability as Mr. Menocal, but I shall have to say something regarding the calms in the Bay of Panama. I am not in favor of M. de Lesseps's route. I think it impracticable, financially and scientifically. I am in favor, however, of the San Blas route, which opens into the Bay of Panama, and I have taken particular pains to investigate that matter of the calms in the Bay of Panama, because I have heard it reiterated, again and again, what difficulty vessels would have in passing into and out of that bay. It is true there is a belt of calms, extending

from about 4° north latitude to 14° or 15° north latitude, and it extends all the way across the Pacific ocean to the China seas. It varies in its width, sometimes extending not higher up than 8° or 10°, sometimes to 14° or 15° north latitude. Within this larger limit is the Pacific terminus of the proposed Nicaraguan canal. The San Blas terminus is in about 8° north latitude. This belt is called by sailors "the doldrums," and is not wholly calms, but full of variable, shifting, light winds and calms. I have taken the opinion of sea captains in the California trade—have gone on their ships and enquired about it—and I have consulted with Mr. Charles Frederick Elwell, President of the Maritime Association of this port, and head of a very old shipping firm that sent out the first supply vessel to California. He said that in a single year his firm had sent as many as 125 to 130 sailing vessels to Panama and Aspinwall, and "they would just as lief go to Panama as to any other port on the coast; there was no difference." Maintaining the view I had fixed in my mind that there was in the Bay of Panama, during about one third of the year, a season of almost perpetual calm, I asked him if there was not a time when there were nearly constant calms in the Bay of Panama, but he wouldn't hear to that. Now Mr. Elwell has no interest in this matter, and he said that his firm "would as lief send vessels into the Bay of Panama as any other port on the coast."

But now, suppose the argument was true, that there were calms in the Bay of Panama, and that the fact was due to that bay being in the belt of calms or equatorial "doldrums," would it not then be apparent to you that, if this belt extends across the Pacific, then vessels passing through the Nicaraguan canal, and coming out near the northern verge of that belt, if bound for any South American Pacific port, Japan, China, or Australia, would have to pass through this belt of calms—through the whole of it? But vessels going through by the San Blas, or Panama route, would only have to pass through one-half of it, admitting the full extent of their argument.

Captain Pim and Lieutenant Maury doubtless stated this as a matter of scientific inquiry, but those men whom I have consulted have realized it, experienced it in their business as a fact, and are, surely, competent to judge of its importance. Now is book knowledge, or scientific experiment and knowledge, to be compared with the practical experience of sea captains and shipping houses who

have carried and sent vessels by the hundred into this very port? Which is worth more, the opinion of one party or of the other? With regard to this Nicaragua route, the subject is so large, the figures so extensive, the plans so elaborate, that if a person has not studied them by days and weeks a very plausible and fair-seeming statement of the different parts of the plans would pass muster, and be accepted almost anywhere, even with an audience as intelligent, and capable of judging of things, as this audience is. But let us look at them a little. You will see, from Mr. Menocal's statement of the width of the bottom of his canal, in rock, that it is 60 feet; the slope of the wall one vertical to one horizontal. That is, at four feet from the bottom you will have a width of 64 feet.

Mr. Menocal: Excuse me a moment. Sixty feet is the width of the bottom of the canal at a depth of 26 feet; at a depth of 16 feet the width is 90 feet, and on the surface of the canal it is 106 feet. But it will be observed, by looking at the section of the water-prism of the canal, that by continuing the slopes proposed of ½ to 1, from the surface of the water to the bottom of the canal, the bottom width will be 72 feet, or more than the Suez canal, and the increase in the excavations will be insignificant, probably not more than 500 cubic yards in the whole extent of rock excavation in the canal.

Major Shelbourne: Even allowing that change to have been calculated in the plans and made, the canal 72 feet wide upon the bottom, with this rise of one foot vertical to one-half foot horizontal, would still, at a height of four feet from the bottom, be but 76 feet wide. But vessels of three, four, and five thousand tons, such ships as would be employed in this interoceanic trade, have a beam of 40 or 45 feet. Now two vessels of that size, each drawing 24 or 25 feet of water, could not meet and pass in that section of the canal, because the outer side of each would graze upon the unexcavated rock. The canal is not wide enough on the bottom in the rock section, and any just estimate of its cost should be based upon a very material enlargement in this direction. Another thing that materially affects the estimates is, that while the canal is calculated on a depth of 26 feet on this route, the calculations for the San Blas and M. de Lesseps's routes are made upon the basis of a depth of 28 feet. Between the lake and the first dam, Mr. Menocal says, is 29 or 30 miles, and the excavation would be made to an average depth of six feet. Now, then, in that part of the river we

have, according to Mr. Menocal's own estimate, some 834,000 and odd cubic yards of rock excavation required to get the depth of 26 feet of water. Then you have a width of 80 feet to obtain; and, understand, that excavation in the rock is not all at one point, but at various places along a distance of some 28 miles, in removing reefs of rock spread out in the river, in some instances only a little to come off, in others more. He says that excavation can be made before the dams are completed—that is, he would have that rock excavation to do under a depth of, say, 10 to 15 feet of water, and that water the current of a river, before a dam is built upon it. My experience shows me that it would be easier to blast out and remove rock from a depth of 26 feet in still water, than under 10 or 14 feet where you have a current of three or four miles an hour, or even less, to contend with. But, granting him the most favorable conditions in still water, Mr. Menocal has put his estimate for this rock excavation much too low. He has placed it at $5 per cubic yard. Now we all know that here in New York harbor, where there is competition and the best appliances, for simply lifting rock from the bottom, and taking it away after it has been blasted out by Gen. Newton, in his work in the East river—and that not in Hell Gate, but from other obstructions he has been removing—the cost has been something like $4.50 per cubic yard. The latest estimate, I believe, was $2.26 per ton, and two tons are calculated to the cubic yard. That would make a difference in Mr. Menocal's estimate of $6,424,245, taking the quantities of necessary excavation he has calculated upon. If you should go to 28 feet in depth, to put figures on a comparison with those of other routes, as all submarine reefs increase in contents more or less largely as they go down, you would have a still greater quantity, an indefinite but vast quantity, to add to the present estimates. Suffice it to say, taking the 10,000 and odd cubic yards of rock excavation at the west side of the lake where the canal passes down to the Pacific, and adding the number of cubic yards in the river where the slack-water navigation is to be, the whole quantity would be 856,566 cubic yards. In this paper he has undertaken to justify the figures he has placed, by saying that Col. Child's estimate in 1851 was from $2.50 to $5 per cubic yard. He has also estimated the gravel and sand dredging in the river, at a depth of 9 to 14 feet, at 2,180,589 cubic yards. Now, if you will look on the map, you will

see the curves and angles of that river, and I should like to ask any engineer, who has practically excavated such a work, whether a width of 80 feet, following the course of such a crooked river, would be wide enough to allow vessels to pass without grazing their sides and bottoms on the rocky sides of that tortuous cut. Again, in regard to the open cut. He has made the sum of that 14,677,389 cubic yards, and he has told you that he has estimated the cost of that at $1 to $1.25 per cubic yard. Now, all engineers who have done any work on the isthmus—among them Col. Totten, Mr. Evans and other gentlemen of practical experience—will say to you that that price is wholly inadequate for that work. In some particular localities it might be sufficient, but not here. To bring the figures up on the basis of the estimates on the other routes would add to that estimate for that open-cut work the sum of $24,535,469, making those two items—the six million dollars necessary increase on the item of rock excavation in the river and these twenty-four millions—something over $31,000,000. Adding that—with the customary percentage for contingencies—to their present estimate, would bring the total cost up to $104,421,790. Moreover, on the canal on the Atlantic end, there is a stretch of seven miles that will have to be constructed through a swamp imbedded with trunks of trees—a perfect network of trees, and stumps, and other material. The removal of this is not so difficult as the fact of maintaining a canal through such a swamp, with such a section as Mr. Menocal has estimated for it. A slope of 1½ to 1 is wholly inadequate. In such a swamp, where it is more or less mud, the material taken out in the excavation of that canal would have to be put far back on the bank. Now, then, to increase the estimate for that part of the canal—those seven miles through the swamp—necessarily to increase it to obtain a work capable of being maintained, to make the slope 4 to 1 and get a width of 100 feet on the bottom, would add some 9,000,000 of cubic yards (double what he has allowed) to the excavation. And when you have done that you will still have to line those walls with rip-rap to get them to stand, besides putting the material taken from the cut far back from it, to prevent its weight and slipperiness pushing it back into the canal. This part of the canal passes through two or three small lakes, and there is a river called the San Juanillo that crosses it almost at right angles. What provision has been made for that river I do not know, and cannot find out from the estimates.

Again, in the lake, there are seven miles, from Fort San Carlos on the east side out into the lake seven miles, where the excavation of the mud has to be to a depth of 10 feet on an average. Mr. Menocal has said that the width of the bottom there was calculated to be 80 feet, with a slope of 4 to 1, and he thought, because vessels would not meet with any wind in that part of the canal, that that bottom was wide enough. Now, in all government works, it has been calculated that a channel, where the excavation is only 3 to 6 feet upon an average, and it is desired to make it navigable for large ships, should have a width of 300 feet at least. I will refer you, by way of illustration of such a work, to the channel which is excavating in the Patapsco river for the improvement of Baltimore harbor, under the direction of Col. Craighill. They commenced that with a width of 500 feet, and have been increasing it.

Mr. Menocal says sailing vessels would probably be able to sail across the lake and not be obliged to take a tow. But this evening he states that that channel would be wide enough because there would not be any wind there. How then could sailing vessels go across the lake without any wind? They would have to be towed across the lake. But, to increase the width of that channel to a width of 300 feet and provide as would be necessary in such soft material, you would have to excavate 12 feet, with a slope of 3 or 4 to 1. A friend who has sailed across that lake tells me that the paddles of light-draft side-wheel vessels would blacken the water by stirring up the mud from the bottom, it was so soft. So, to maintain that cut there, you would have to be continually dredging to keep it 300 feet wide, and you would have to buoy it to make it convenient or safe even for steamers. As regards the harbors on both sides you have had sufficient information, and are able to judge of the difficulties in the way of constructing and maintaining them. I do not see any difficulty in creating a harbor on the Pacific, but I do see difficulty, not in creating, but in maintaining one on the Atlantic side, and if any of you will see the length of the line of coast directly east from Greytown, you will appreciate how long a breakwater will have to be built, how far out it will have to be built, before the direction of the prevalent wind will be at right angles to the bank that is formed between the breakwater and the present coast.

Mr. Menocal: How far?

Major SHELBOURNE: I think the coast extends almost directly eastward from the entrance to Greytown harbor for a distance of a mile to two miles.

Mr. MENOCAL: And how long will the jetty then have to be?

Major SHELBOURNE: Well, that is a mere matter of engineering calculation.

Mr. MENOCAL: Oh! and I suppose you have not studied that?

Major SHELBOURNE: Oh, I don't assert that a harbor cannot be maintained there, but any jetty built will be only temporary in its effect, and it will continually have to be extended.

Mr. MENOCAL: The question is how far it will have to be extended before we have the sands drifted by the action of the winds at right angles with the present coast?

Major SHELBOURNE: Well, my impression is that the coast extends a mile, or a mile and a half directly east. Now, if the winds strike that coast at an angle of 45°, that jetty will have to be extended to make a right angle with the coast. If Mr. Menocal will be present at any future discussion, I will be careful to make the estimates, and tell him how long the jetty will have to be before the conditions he desires will be attained.

In regard to the matter of locks, and the time of passing through them, that is a matter for every engineer to judge for himself. I want to say, however—though I do not wish to be understood as offering it as a valid objection against the lock system—that if you calculate the area of the present pipes that Mr. Menocal has located in his locks to fill them, taking the velocity of the inflowing water at 10 feet per second, it will take, as you will find, some eighteen minutes for the water to fill them. I do not say those pipes cannot be increased, but I do say the present estimates are wholly inadequate. I think it is fair to remind the gentlemen present that the commission of which Mr. Menocal speaks, said that, as far as the scientific work in the surveys was concerned, they found no fault with it, but at the same time they say—and Mr. Menocal has so admitted in a paper he wrote for *The Engineering News*—that this commission found that in some instances the prices put upon this work were not altogether adequate.

Mr. MENOCAL: I think you are in error, sir. I did not say, "the commission," but "some members of the commission." The fact is, that there was but one out of the five, Major McFarland, who

entertained that impression, but in writing that article I did not wish to seem personal, and so wrote "some of the members," instead of "one of the members," which would have been correct.

Major Shelbourne: I do not stand here to correct the gentleman as to what he said on a former occasion. I simply say that to bring the prices on a par with those upon which the estimates of the other routes are based, is to add for two items alone an increase of about thirty-one million dollars to his estimates.

In regard to this matter of earthquakes in Nicaragua, and the different parts of the isthmus, the fact appears to be this: When you take the very narrowest parts of this isthmus, as it is at San Blas, and very little more between Panama and Colon, you find that it is not altogether free from slight shocks, or tremblings of the earth, but they were never known to have done any damage. You know some years ago, Caraccas, which is on the body of South America, had a very severe earthquake, in which the whole city was destroyed. I have not enough data by which I can say that my remark will be borne out by experience or scientific conclusions, but it appears to me, from the data I have seen and the information I could gather, that where the continents begin to widen out, so as to form a broad area, that earthquakes are more numerous and more severe. When you get into the body of South America the earthquakes are sometimes very disastrous, and you know earthquakes are very severe in Mexico. The idea seems to me to be this: Here you have a narrow region of isthmus with more or less depth of ocean on each side, and, as an earthquake must be due to internal commotion of the earth—volcanic or whatever you choose to call it—and will be disastrous in proportion to the resistance offered to that force finding its exit on the line of least resistance; so, if you take the isthmus at San Blas—1,500 feet high and very narrow—there it would seem the earthquake force would find its way out without any great resistance, and consequently without provoking any very great effect, but in South America it would have to exert a greater power to find the line of least resistance and effect its exit. So above in Nicaragua also, where the isthmus is wider.

There are other points, but I hardly feel like taking time this evening to develop them.

Mr. Menocal: I would like to say, in regard to the gentleman's proposed alterations in my estimates, that from all the information

I have been able to obtain, I am led to believe that the excavations, under water as well as out, can be executed along the whole route for the prices stated in these reports, and a very responsible person here in New York has told me they would be very willing to take the contract for all the rock blasting and dredging at the prices estimated.

As to the winds on the lake. I have said, and I say, that the winds do not prevail on that portion where the lake would have to be dredged, as that part is shielded by mountains. It would therefore be necessary for a vessel to be towed along the river and into the lake until she got a fair wind, beyond this sheltered corner, and then her way would be open for her all across the lake, for progress by the aid of her own sails.

As to the channel through the swamp, it is not proposed to bank the excavated material, but to dump it in the little lakes and the lower channel of the San Juan.

Q. What is the material ?

Mr. Menocal : Sand and clay, and as to a doubt of its standing a slope of $1\frac{1}{2}$ to 1, I will simply say that the natural banks of all these lakes, as they stand, have a slope of $\frac{1}{2}$ to 1, so that they have deep water very close to the edge. In that little lake (indicating upon the map) you have ten feet depth of water within five feet of the edge, and the center depth is 16 feet. All this material, as has been said, it is proposed shall be dumped into these little lakes and the channel specified. There is no proposition to form dykes on the sides of the canal.

Q. How high are the natural banks around those lakes ?

Mr. Menocal : On the south and west sides they are high, though I do not remember the exact altitude now, but all this (indicating the other margins on the map) is low land.

Q. How far does that river extend across the channel, and what is its character?

Mr. Menocal: It is simply an outlet of the Rio San Juan, and it is proposed to cut it off altogether, which can be done very easily.

Q. Do you propose to blast any rock in a current like that at Hell Gate?

Mr. Menocal : Oh no, not at all. There is a short place where we might have to blast at a depth of nine feet, in a current of five miles an hour, and as we blast away the rock which acts as a

dam, the current will increase, but it can be at no point so violent as to offer any serious obstacle to the work.

Q. You have spoken of it as trap rock. Is it at all similar in character to that about here?

Mr. Menocal: Oh no. It is loose and fractures easily, while this you have to encounter here is very hard and compact.

Q. Hard rock, like granite, would increase the cost of removal?

Mr. Menocal: Yes; naturally. But I can say that responsible persons here are willing to take the contract for all that work at the prices named in the estimates. Those estimates are correct, and no engineer of reputation, conversant with the facts, has—heretofore—criticised them.

Mr. A. L. Ford: So far as it affords an indication of the actual cost of earth excavation in that country, I will say that a large contract has just been made in Nicaragua for the construction of 80 miles of railroad, and the contract has been taken by Mr. Norris. His basis of figures for the earth work is on 30 cents per cubic yard for all kinds of earth, not merely light loam, but stiff clays and some swamp; and he based his figures on calculations including the rainy season and a prospective increase in the price of labor—for the entire labor market of that country is affected by a contract of such magnitude as building 80 miles of railroad.

Mr. Menocal: I would like to call the attention of engineers to the fact that, in the construction of the proposed canal across Nicaragua, the work is not concentrated at any particular point, but extended along the whole length of the line; so that the men can be put to work at the same time from one end of the canal to the other, and the work can be completed in a relatively short time as compared to the time that would be required to build a canal by either the San Blas or the Panama routes, where, on account of the proposed tunnel and of the deep cuts, only a limited number of men can work at once.

Chief-Justice Daly: It is now twenty minutes to eleven o'clock. This discussion will be continued next Monday evening, until which time this meeting will stand adjourned.

INTEROCEANIC SHIP CANAL.

Special Meeting of the American Geographical Society, held at their rooms, on the evening of Monday, December 22, 1879.

Among others, there were present—Chief Justice Daly, the President of the Society, Mr. William H. Webb, Mr. John E. Body, General E. W. Serrell, Civil Engineer, Mr. Elial F. Hall, Mr. Octave Chanute, Mr. D. S. Moulton, Mr. Jess Young, F.R.G.S., Major Sidney F. Shelbourne, Mr. James M. Bowman, and Mr. Simon Stevens.

Upon calling the meeting to order, the President said that it was the intention to devote the evening to the consideration of the San Blas route for an isthmus canal, the last meeting having been given to the consideration of the Panama route, which led to the presentation of claims on behalf of opposing routes, among which was the San Blas.

The President said : Before the investigation commences, I think I should call the attention of those present to the fact that an address was made before the Committee on Technique, which, as I understand it, was the chief scientific committee of the Paris Congress, appointed to examine preliminarily the various routes, their advantages and disadvantages, by Mr. De Courcey, a civil engineer. The fact that he addressed such a committee is of itself an indication that he was a person of some consequence in their estimation ; and that his address was considered of importance, I infer from the fact that it has been translated and published in the last number of the *Popular Science Monthly* in this country.

I wish to call attention to three statements that he makes, one of which is certainly very extraordinary for a civil engineer professing to speak upon a subject with which he assumed to be acquainted—that is, to the effect (I give his language as in the translation) that to carry out the San Blas project a harbor must be built on the Atlantic. Now, it is known to geographers—at least, to all American geographers—that the bay of San Blas is a very remarkable one, and that in the northwestern portion of that bay, at the mouth of the Mandinga river, which is to be the mouth of the projected canal, there is a very fine harbor capable of accommodating vessels of any

depth of draft. At least, that is the fact unless all the information we have hitherto received is unfounded, and Mr. De Courcey has information which we do not possess.

The other statement is, that at the mouth of the Bayano river, which is to be utilized for the canal on the Pacific side, and at the mouth or near the mouth of which the canal is to terminate—that on that side there is a bar which he says it is by no means certain can be mastered. He may be correct in this statement, for I am not particularly informed in regard to the mouth of the Bayano; but there are gentlemen here who are, perhaps, informed upon that subject, and who can tell us whether there is such a bar, and whether the difficulties are so great as Mr. De Courcey suggests.

The last statement is in respect to the proposed tunnel on the San Blas route. He says that shipmasters do not take kindly to a tunnel with so long a passage without fresh air; that they will have an unconquerable antipathy to passing through it, even with the aid of an electric light. The passage through this tunnel as estimated, so far as I understand, will occupy about two hours—which amounts to the proposition that a shipmaster, from his "unconquerable" repugnance to a tunnel, would prefer carrying his ship around Cape Horn instead of going through a tunnel in a passage of two hours.

I mention these three facts, as they are reproduced in a publication here for the information of the American public, to show how, in my judgment, even in the most important committee of the Paris Congress, they were misled in respect to the true facts by gentlemen professing to have knowledge of them.

Major Shelbourne, who was heard on the previous evening in a criticism of Mr. Menocal's exposition of the Nicaragua route and its superior advantages, is here. If he is willing I will call upon him, and we shall be glad to hear from him as full an exposition of the San Blas route as he is disposed to make, giving us as far as he can an exact account of what is proposed to be done, the nature of the country through which it is proposed to pass, the character of this tunnel, and, so far as such a matter can be now judged of, its estimated cost, or any other matters which he deems essential in connection with it.

Major Sidney F. Shelbourne then came forward and spoke as follows:

ADDRESS OF MAJOR SIDNEY F. SHELBOURNE.

THE NICARAGUA ROUTE.

Major SHELBOURNE said : Mr. President and Gentlemen,—Before entering upon the principal subject of discussion for this evening, I beg your indulgence for a moment while I return to a detail of the Nicaragua route, which was under discussion at your last meeting, a week ago, and in which Mr. Menocal undertook to question a statement that I had made in reference to the breakwater or jetty, and the silt that would throw around it. His statement was to the effect that the jetty would be, as I understood him, some 600 feet long from the shore, and that it was intended to stop the drift of the sand along the coast, as it is now formed there, at the harbor of Greytown, and that eventually the condition would arrive in which the northeast trade winds, which now strike the present coast at an angle of 45 degrees, driving the sand along it, would fill up the angle to be formed by the breakwater with the coast so as to create a shore-line at right angles to the direction of the wind ; and thereafter the sand, instead of drifting westward in the direction of the proposed outlet for the canal, would be turned in another direction, and be driven towards the south.

I stated that the coast at that point trended almost, if not directly east, for a distance of between one and two miles. I had not made an exact measurement of the distance on the scale, and the question which Mr. Menocal put to me was as to the length of the coast trending directly eastward along which the sand would drive. Not wishing to speak at random, I said I would make a calculation, and at the next meeting of the Society I would present it.

Those of you who can see this portion of this map will see the direction of that coast. That point [referring to a location on the coast as delineated on Map No. 4, accompanying the report of the surveys of the Nicaraguan route by the United States government] is the proposed breakwater. It is not proposed to be built at right angles to the coast, but at an angle of about 115 degrees with the trend of the coast. I have produced here [exhibiting a diagram of the coast and an extended breakwater on a scale of one mile to the inch] a rough idea of the conditions which will obtain. This coast, from the place where the breakwater is proposed to be

built out from it, trends directly east, as you see by the map, not a mile and three-quarters, as I stated, because I did not want to speak without exact knowledge, but I find, upon a calculation upon the plans and maps made by Mr. Menocal himself, that the direction of this coast eastward is for a distance of two miles and ninety-three one-hundredths from the point where the breakwater is proposed to be built. I stated that the sand driving along that coast would very soon fill up the angle between the shore and the end of the breakwater ; and then the breakwater would need to be continually extended in order to prevent the sand from drifting into the mouth of the canal. You will see, then, since the northeast trade winds strike this three miles of coast at an angle of 45 degrees, the conditions for turning the sand in another direction, which Mr. Menocal hopes to attain, will not arise in Greytown harbor until this breakwater is extended out a distance equal to the distance from the shore end of the breakwater to the point eastward where the coast faces off towards the sonth, which is about three miles.

The length of the breakwater, as it is proposed to be built, if I understood Mr. Menocal's statement correctly, would be represented on this diagram of a scale of one inch to the mile, by a line only one-eighth of an inch in length. But the condition of safety for the canal would not be attained until the breakwater actually built could be represented on this same scale by a line nearly three inches in length, so that when the breakwater shall have been extended for a distance of three miles from the shore, and the angle formed by it with the three miles of coast should become filled up with sand, the wind would then drive the waves bearing the sand at right angles to the new-made shore, and the movement westward would probably cease and possibly the sand find an easier lodgment in another direction. Now, 600 feet is a little less than one-eighth of a mile ; consequently, if the breakwater is to be 600 feet long at the commencement, it would have to be extended twenty-four times its whole length before the condition of security would arise. The danger of the sand drifting into the mouth of this canal around the breakwater, and its rapidity of lodgment, will be apparent to you when I repeat Mr. Menocal's own statement that a half million of cubic yards of sand and debris is brought down by the San Juan river and fed to the waves of the sea through its outlets at and

near the harbor of Greytown—a half million cubic yards every year.

Mr. Menocal has said that all engineers who have examined his plans for a breakwater here at Greytown have approved of them, and that they were approved by the Paris Congress. I think you all will approve of this proposed breakwater as a makeshift for the present, and as the beginning of a very prolonged struggle with a herculean difficulty. However, Mr. Menocal himself states that it will need to be extended from time to time. In that statement he admits the whole objection. I should approve of it, too, if the Nicaragua route were the only canal route, and every engineer can see that to build a breakwater or jetty at right angles to a coast along which the sand is driven, will stop the sand for a certain length of time.

THE SAN BLAS ROUTE.

Turning from the subject of the Nicaragua canal to that of the route by way of San Blas, I have to say, in the first place, that every feasible and available route except San Blas, every route that is now brought to the public ear, has had its government surveyor and its official volume, containing very extensive letterpress and numerous detailed maps; but the San Blas route has nothing to represent it that the government did or paid for, except two small maps among seventeen contained in Commander Selfridge's report, the letterpress of which, relating to the San Blas route, is comprised in six pages.

It was the great misfortune of the San Blas route that a private citizen spent his money and sent his engineers down to the isthmus some six or seven years before the first of the prominent government surveys were made, and the fact that he thus surveyed this route, and made his map of it, and advocated it, so that it was called the "Kelley route," was enough to condemn it in the eyes of the government officials. A naval officer does not take his cue from a civilian, nor, if he can help himself, does he propose to take a secondary place in any project, scheme or exploration that a civilian has commenced and carried to a certain progress of demonstration. Therefore the naval officers—each one who made a survey upon the isthmus—had routes of their own, and Selfridge, who merely went to the Gulf of San Blas after the beginning of the rainy season, and

spent a few days there and made a reconnoissance up the mountain, following the crooked beds of the watercourses and a partial and tortuous chain and level survey upon the ridge, in his report elaborates a route that his own name could lead, the Atrato Napipi route, and the great bulk of his maps are devoted to the detailed plans of that route, commencing in the Gulf of Uraba, and ascending the Atrato river for 150 miles, and reaching the divide in the general line of the valley of the Napipi with a tunnel through the ridge, and with locks down to Cupica or Limon bay on the Pacific. The Tehuantepec route, surveyed under Captain Shufeldt, has its volume bound in red, perhaps because it is a demonstrative color. The Nicaragua route has its volume, the final survey being made under Commander Lull. The Panama route has its volume, and, as I have just said, the Atrato Napipi route dwarfs everything else in the voluminous theme of Commander Selfridge. I will not, however, undertake to explain how it happens that each naval officer has come to have his judgment invariably set in favor of that route the report of which bears his own name in large capitals on its title-pages. It is, undoubtedly, natural that a father should love his child, and wish, too, to be publicly recognized as the father of his own.

But if the officers of the United States government have failed to give to the San Blas route that attention which it deserves, and if it is not represented before you to-night by a detailed report of a government officer and by maps of profiles and sections, and plans and minute details, elaborated at Washington, it may fortunately be said that nature herself has presented her strongest arguments for the San Blas route, and the geographer, true to her, as he hopes to declare the merits of his work, has delineated them in every school atlas, and they may be found upon the shelves of every scientific society. It is enough to say that it has long been shown in all atlases that at San Blas the isthmus comes to its very narrowest—less than 27 minutes of a degree of latitude—as Mr. Sweet makes it, and Mr. McDougal's survey, 30 miles and a small fraction. Commander Selfridge, however, represents it in his report as being 37 miles from ocean to ocean. How he arrives at this length I cannot imagine, while on his map, according to the scale, the whole direct distance across from ocean to ocean is a trifle under 30 miles. As this latter distance agrees, within a few

feet, with the results of McDougal's survey, it should be assumed to be substantially correct. If Commander Selfridge had taken the trouble to determine the true latitude and longitude of the shore on the Pacific side at the mouth of the Bayano river, we could have known the exact distance across the isthmus at this point to within at least 150 feet. None of these maps which are hanging on the wall before you will show the direction to the Gulf of San Blas from New York; but bearing in mind that the longitude of New York and the eastern point of Cuba is about the same, being 74° west from Greenwich, the route as far as Cuba will be in a great circle, and taking what is called the windward channel, we pass the eastern extremity of Cuba, and then bearing southwest by south, we also pass the eastern point of the island of Jamaica, striking the Gulf of San Blas on a direct course, and passing Point San Blas on a southwest by west course, we enter the magnificent harbor of Mandinga. Now, the distance from New York by the passage I have delineated to the proposed San Blas canal is 85 miles less than that by the same windward channel to Greytown, the Atlantic terminus of the proposed canal through Nicaragua. We will commence with the exposition of the San Blas route on the Atlantic side, while on the Nicaragua route they have usually commenced on the Pacific side. We reach, then, across this open sea, the Gulf of San Blas, as represented upon this map [referring to Mr. Kelley's map of the San Blas survey loaned to the society], and 85 miles nearer to New York, as I have said, than Greytown. This map was made by Mr. Sweet, one of Mr. Kelley's engineers engaged in the survey. This survey was made in 1864, under the auspices of Mr. Kelley and Mr. Cyrus Butler, and no complete survey of this route has ever been made since, but only a reconnoissance and partial survey by Commander Selfridge in the expedition of 1870. The engineers of Mr. Kelley commenced their survey upon the Pacific side. Pausing here, I will say that this harbor of Mandinga was surveyed by Commander Lull, then under Selfridge, but afterwards having command of the expedition which completed the survey of the Nicaragua route. It was commenced in April, 1870, and was completed during the time of the land survey of the San Blas route under the other officers of Commander Selfridge's expedition of that year. Lull spent twenty-five days altogether in the

survey of the approach to this harbor, and in a trigonometrical survey of the harbor itself and the Gulf of San Blas. There is an area here in the harbor of as much as nine square miles, where a vessel can ride at anchor at all times with perfect safety. As you approach this harbor from the Gulf of San Blas through the channel which has been named after Admiral Porter, and pass the southernmost of an extended parallel group of islands which form its northeast boundary, the depth of the water in the harbor is 112 feet and as you pass inward towards the delta between the mouths of the Rio Mandinga, you have a depth of 30 feet within 300 yards of the shore. The bottom of this harbor is a clay and clayish mud, so you see it affords an excellent holding ground. The mouths of the Mandinga river are not shown upon Mr. Kelley's maps, except one of them, as you will see here by this slight shore indication, which was perhaps plotted afterwards from Commander Lull's survey of the harbor. The river Mandinga has two mouths opening into this harbor of the same name. The reason that Mr. Kelley's engineers have not located the mouths of the rivers Mandinga, Vercalagua and Carti, which open here into the gulf of San Blas, is that at the time their survey was made in 1864 this tribe of Indians inhabiting the Atlantic slope of the Cordilleras at San Blas had been almost entirely excluded from contact with civilization, and were very hostile. They were very jealous of the presence of strangers, and when Mr. Kelley's party of engineers and surveyors got over the ridge down to the low land—for about three miles the ground does not rise more than four or five feet above the sea level, and during the rainy season it is a part of the time overflowed—when they got down here the Indians made hostile demonstrations, and the surveyors were obliged to get back over the mountain.

I have here a small map, which Mr. Curren has kindly pinned up for me, which was made under the auspices of Commander Selfridge, and is map No. 12, accompanying the report of his expedition of 1870. It will show you the chief features of at least the Atlantic division of the San Blas route, and the details of Mandinga harbor and the Gulf of San Blas, for it was to these features, not examined by Mr. Kelley's engineers, that the most of his attention was directed. As this map is very poorly plotted, and as the lines are not in colors and not very prominent, it will be very difficult for those of you in

the back of the room to see the details of this Gulf of San Blas. At any rate, I can explain to you that Point San Blas, shown on this map, is the point of the mainland the furthest towards the northeast of this whole region of the isthmus lying to the south, southeast of Aspinwall, and that it forms the northern shore of the large Gulf of San Blas, enclosed between it and the mainland, at the mouth of the river Carti on the south. The entrance to the Gulf of San Blas is from the direction of northeast by east. There are a number of outlying islands here, which protect the gulf and the interior harbor of Mandinga, and make it safe at all times. The entrance, however, into the interior harbor is by a broad channel, called, as I have indicated, Porter channel.

This Mandinga harbor, then, embracing an area of about nine square miles, is intended to be the Atlantic terminus of the San Blas interoceanic canal.

The two mouths of the Rio Mandinga are separated from each other by a distance of two and a half miles, while it is only one and a half miles in a direct line across the delta from the shore to the point where the river separates into its two outlets. Altogether, for a distance of three miles in a direct line from the harbor shore, the Mandinga passes through low ground, scarcely elevated above the sea, and then we begin to find rising ground as we ascend in its bed. If we were standing upon the slope of the Cordillera to the southwest, and looking towards Mandinga harbor and the Gulf of San Blas, and the dense verdure and intervening ridges did not obstruct the vision, we would see the Mandinga river on our left entering into the harbor towards the east; the Rio Vercalagua before us, and partly to the right, also entering into Mandinga harbor, further towards the right and in a northerly direction; and on the extreme right the Carti river entering into the Gulf of San Blas, in a northerly direction, near the easterly limits of the southern shore of the gulf next to the sea.

As the Rio Mandinga is quite to the left, and the Rio Carti far to the right of the proposed line of the canal, their peculiarities and water-shed do not enter into the problem before us, although both of these rivers find their source far up towards the centre of the isthmus. But the Vercalagua more directly interests us, because through a portion of its upper valley would the open cutting of the

canal on this side of the Cordillera be made. It has its rise on the Atlantic slope of the Cordillera, about seven miles in a direct line from the harbor of Mandinga, and when you get three or four miles from the harbor, and strike its valley, it is nothing but a little mountain rivulet, sometimes dry, but in the wet season a little mountain torrent. The open cutting of the canal would strike the bed of this river at a distance of two miles from the point where the canal begins, at the harbor of Mandinga, and follow its bed in general direction for another half mile, when it again leaves its bed, and takes the valley to the right or southward of the stream itself, to the point where the tunnel would commence, five miles from the harbor of Mandinga. It will be seen, therefore, that the Vercalagua will have a new direction or debouchement given to it from a point two miles and a half from the harbor of Mandinga, by the embankment of the rock debris brought from the tunnel, and that its outlet into the harbor will then be near the southernmost mouth of the Rio Mandinga.

I will now go forward and locate for you the termini of the proposed San Blas canal, and give you the approximate length and character of its sections. Its Atlantic end would be in latitude 9° 26′ 56″ north and longitude 79° 2′ 50″ west, the harbor of Mandinga presenting at this point the nearest available approach southward towards the ridge of the Cordilleras. This end of the canal may be further located on the map by a distance of 2 miles 550 yards in a direction west by southwest from the mouth of the Rio Vercalagua. The first section would be five miles of open cutting in a generally south southwest direction. Then would follow the tunnel for a distance of seven miles through the Cordillera, varying but little in direction from a meridian of longitude, and terminating upon the Pacific slope of the range about a half mile east by northeast of the falls of Salto. From this point the canal would be led by an open cutting a distance of 12 miles into the Rio Bayano at its great bend, a point six miles from the Bay of Panama. And now returning to the Atlantic side, let us follow this work more in detail. The five miles of open cutting commencing at Mandinga harbor would pass for a distance of two miles through a lowland, which lowland is not a mud—not a soft mud—since it is composed of a reddish yellow clay in the main part, with some vegetable decomposition and dark alluvium upon the surface.

For nearly three miles the cutting would be quite light. I may say in this connection that the tide passes up this river, the Vercalagua, for a mile and a half, and the tide only rises and falls on an average eight-tenths of a foot in the harbor of Mandinga, so that you can see how little the rise of the ground must be for that distance, since eight-tenths of a foot brings the tide a mile and a half up that river. After you get three miles in a direct line from the harbor of Mandinga, the ground begins to rise rapidly until, at a point five miles from the harbor, you come to an elevation 190 feet above the surface of the sea.

It has been laid down, and seems to have been agreed to by engineers generally, and by persons who have studied this subject, since no one has presented adverse views, that when you arrive at a depth in open cutting of 190 feet above the sea that it would be cheaper and more desirable to make a tunnel. If this depth of open cutting, therefore, be taken as the proper one for commencing the tunnel, the length of the cutting of this depth would not be more than a quarter of a mile in the situation under our consideration, for the surface of the ground immediately falls down to an elevation of 166 feet, then to 130, 98 and 66 feet at the middle point of this five miles of open cutting, while the average of the remainder is but a trifle above the sea. It is to be observed, however, that when we add 28 feet, the depth of the canal below the sea level, to the 190 feet of open cutting above that level, we will have, for a few rods of open cutting just at the mouth of the tunnel, a depth of 218 feet, and the tunnel being proposed of a height of 168 feet above the bottom of the canal, it will be seen that there will remain above the arch of the tunnel at its commencement a roof of rock of a depth of 50 feet.

Two routes for the tunnel suggest themselves to those who have studied the features of this portion of the isthmus, slightly varying from each other in their outlet on the Pacific side; but which would be the most advantageous would depend upon more accurate surveys.

There have been a great many fears expressed, and a great many doubts entertained in regard to the feasibility of the tunnel—in regard to its cost—in regard to its utility after its construction, and in regard to the stability of its natural arch, involving the question of the probable necessity for supplying a masonry arch for the whole length of its seven miles.

Judge Daly: And the danger of the inflow of water?

Mr. Shelbourne: Yes, that is one of the expected difficulties—the infiltration of water through the rock into the tunnel while it is being excavated the 28 feet below the surface of the sea.

I wish, however, first to speak of the problem of the length of this tunnel. There is a wide discrepancy between the two surveys, or partial surveys, as we must call one of them, in regard to the distance through the Cordillera at an elevation of 190 feet above the ocean, and consequently in regard to the probable length of the tunnel. It will be worth the time to explain how that arose.

If you will follow the direction of the river Bayano, on this map of Mr. Kelley, up from its mouth at the Bay of Panama to the junction of the river Mamoni, and then up that river to the dividing ridge and over it, you will trace the principal line of survey made by Mr. Kelley's engineers. Commencing in the Bay of Panama, they made an accurate survey up the Bayano and the Mamoni, locating all the bends, banks, spurs of hills and points of shore, and passing in the same way up the Mamoni, skirting a spur or ridge of hills on their right, which approaches from the east close to the Mamoni, they came up that river to the falls of Salto, in the first range of the Cordillera on that side through which the tunnel would have to be made. Knowing the general direction of the proposed tunnel to be north from the point where they were, they took the bend of this first range of the Cordillera, and found, instead of its being directly east and west, that it fell away toward a point north of east on their right; they therefore surveyed along the foot of this range towards their right for something more than half a mile, and located the Pacific end of the tunnel, as they thought, in the most favorable and advanced position northward to be found in the base of the mountain. Returning to the Mamoni, they continued a chain and level survey up the circuitous valley of this river, noting every angle with their instruments, and coming to the sources of the Butler river, a north and south branch of the Mamoni, they passed over the divide, and finding the head-waters of a branch of the Samgandi, they passed down the Samgandi and the Mandinga, with which it joins, to the base of the Cordillera on the Atlantic side, where, as I have said, they were driven back by the Indians. Now, as far as the mountain itself is concerned, this survey of Mr.

Kelley's engineers, although it was a series of circuitous valleys, was, nevertheless, unique and complete, and the determination, upon a scale, of the consecutive series of angles obtained, will give us the distance in a straight line from one side of the mountain to the other. That they did not go from the base of the mountain on this Atlantic side to the harbor of Mandinga, here shown on Selfridge's map, and obtain the exact distance, and locate the mouths of the rivers which flow into the harbor and gulf, and get the topography of the harbor and the bearings of this point of San Blas and all the locations hereabouts, does not make any difference as regards their survey of the ridge of the mountain.

You see that this map [referring to map 12 of Selfridge's report], so far as the Pacific side is concerned, was made entirely from Mr. Kelly's survey. Here is almost, if not quite, a complete copy, on a reduced scale, it is true, of the curves and bends and direction, and everything else, of this river Bayano. Nobody made a proper survey of this side of the isthmus for this route, except Mr. Kelley's engineers, that I am aware of. Mr. Kelley's engineers passed over this ridge entirely. Mr. Selfridge's engineers, when they made their survey six years later, commenced on the Atlantic side in the harbor of Mandinga, and passed up the valley of the Mandinga river and its branches, in the same circuitous way in which Mr. Kelley's engineers came down, until they passed over the ridge, and came to the junction of the river San Jose with the Mamoni, where they fixed upon the marks of Mr. Kelley's survey, and joined their line with his. Commander Selfridge says, in his report, that they met Mr. Kelley's survey at the junction of that river, San Jose, with the Mamoni, and that they found there only half a mile of difference or variation between the location of that point, as determined by his own surveyors and the surveyors of Mr. Kelley. And he says further, that this half mile of variation shows the accurate work of Mr. Kelley's engineers, for they took their base line from the coast line of the Pacific, while his own party took their line from astronomical observations; and he says of the Pacific shore line, that it "is doubtless half a mile in error." Now, Mr. Selfridge's surveyors, in plotting this map [No. 12, before referred to], went to work to join their survey to Mr. Kelley's surveys, and they brought out this sheet accordingly. It is a hybrid production, part of one sort and part of another; and in the merging together of two surveys it may be readily understood how, when they plotted their map, they could

make upon it the distance through this mountain here, in a direct line, to show ten miles or any other imaginable approximation. That there is an error in this map [No. 12] is apparent, for this reason. You will observe the direction of that ridge of the Cordillera [the first extended ridge on the Pacific side on which are located the falls of Salto]. As it has been plotted on this map [No. 12] it is almost at right angles, if not at right angles, to the proposed direction of the tunnel. Upon the general map of the Isthmus of Darien [map No. 1, accompanying Selfridge's report], that range of mountain immediately to the eastward of Salto falls turns to the northeast until it meets the longer range bearing south of east. By measuring the distance from a fixed point on the Bayano river, on the scale of Selfridge's map, to the points of this range of the Cordillera, as shown on the map, and comparing these distances with the same distances as determined on the scale of Mr. Kelley's map, from which the other was made, an error appears in Commander Selfridge's map, in a single particular alone, of one and one-half miles. I compared the distance and pointed out the error to General Newton, who seemed to agree with me that the method of detection was conclusive.

Another point is this : In determining the length of the tunnel through this mountain to be ten miles, Commander Selfridge took his starting point on the Atlantic side from the valley of the Mandinga and his elevation above the sea at 160 feet, counting 30 feet for the bottom of the tunnel below the sea level to make up the 190 feet for his tunnel starting point. Now, the valley of the Mandinga, looking down the Atlantic slope, is quite to the left and decidedly away from the direct and shortest cut through the mountain, and his elevation of 160 feet in the Mandinga valley is much to the rear of the point adjacent to the valley of the Vercalagua, where the tunnel would commence.

A further indication is worthy of notice. A member of the party which surveyed the Rio Vercalagua, states in his report that the mouth of this river has a direct south bearing from the point of San Blas, while in fact it is located on Commander Selfridge's map nearly four miles to the westward of that bearing. If the reporting officer had made that statement of the mouth of the Rio Carti, either the map or the officer would have come within two-thirds of a mile of the truth. These various particulars, then, show that this map of Commander Selfridge, being plotted by the surveyors who

made a partial survey and appropriated Mr. Kelley's surveys for the rest and filled up a gap of half a mile at the point of junction, is altogether unreliable as to the distance through this mountain and the length of this tunnel; while Mr. Sweet, who has in his note-book every particular of his work over this whole ridge, since this question came to be talked about and since the sitting of the Paris Congress, has gone over the details of his map and the length of this tunnel, and he cannot find any error in it. So that it may be taken for granted, upon all the best information that we have at present, that this tunnel will not be more than seven miles long.

Judge Daly : At what point of elevation do you place the commencement of this tunnel? I ask the question for this reason : If I correctly recollect, Commander Selfridge in his report states that the tunnel will have to commence at about 350 feet of elevation, assuming that he makes the distance ten miles.

Mr. Shelbourne : 190 feet above the sea is assumed as the elevation for commencing the tunnel. I am not aware that Commander Selfridge so spoke of the San Blas route. I cannot find any such statement in the text of his report. He speaks, however, in a supplement to his report, of a possible lock canal on this route, with thirty-one locks, to gain an elevation of 372 feet, and then a tunnel of seven miles through the ridge. It may be, though, that he has made some such statement as you name of the Napipi.

Judge Daly : I think not. I will send for the report.

Mr. Shelbourne : We then have the length of the tunnel, as far as we are now able to determine it.

I want now to advert to the method which was very feasible to Commander Selfridge, with the facilities at his command, for determining the length of this tunnel astronomically. You will observe that the direction of the tunnel is almost exactly upon a meridian of longitude; that is, the question of longitude, for determining the length of the tunnel astronomically, does not come into the problem. Conceiving that such a simple method of determining the length of that tunnel would be feasible, I wrote to the Naval Observatory at Washington, and I have a letter from Rear Admiral Rodgers, which, with your permission, I will read :

U. S. Naval Observatory,
Washington, *September* 9, 1879.

Dear Sir: It is difficult to answer your question, since the skill of the observer is so important an element; but in a night a zenith telescope may, in good hands, be put up and a result obtained for

the station, with a no greater probable error in latitude than the quarter of a second.

With this error assumed for each end of the line, the probable error in the length of the tunnel, supposing that the stations are upon the same meridian, will be found by this formula :

$$\pm \sqrt{(0''.25)^2 + (0''.25)^2} = \pm 0''.35.$$

This represents a probable error of some 36 feet.

Yours very respectfully,

JOHN RODGERS,

Rear Admiral, Superintendent.

I also wrote to Professor Peters, of the Litchfield Observatory at Clinton, and he writes :

LITCHFIELD OBSERVATORY OF HAMILTON COLLEGE,

CLINTON, N. Y., *September* 16, 1879.

SIDNEY F. SHELBOURNE, Esq.

Dear Sir : An experienced observer, with suitable instruments, should be able to determine the latitude of a place by one night's work to within one or two seconds of arc, that is, about to within 100 or 200 feet.

Yours respectfully,

C. H. F. PETERS.

Both of these eminent gentlemen agree, then, that with such a telescope as Selfridge had at his command, his parties might have placed their station of observation at an elevation of 190 feet up the Rio Vercalagua on the Atlantic side from the harbor of Mandinga, and in one night made an observation; and upon the Pacific side at an elevation of 190 feet, and in one night made an observation, which would have determined within at least 200 feet the length of this tunnel, and settled this question upon the basis of fact, and not upon that of conjecture. But these observations were not made, and while the party attached to Commander Selfridge's survey had an astronomical station upon the shore of the harbor of Mandinga and determined its position, we have no account of any observations made anywhere on the interior of this route or on its Pacific side. It was Lieutenant-Commander Eastman who made a hydrographic survey of the Bayano river on the Pacific side; and in regard to the point that Judge Daly mentioned at the opening of this meeting, as coming from a statement made by a member of the Paris Congress before the Committee on Technique, that an insurmountable bar existed at the mouth of the Bayano, I will say that the report of the officer making the survey says that a bar had

been located there by all the charts with not more than six feet of water on it, but that he found no such bar; but, on the contrary, a channel into the river of a depth of 15 feet at low water, sufficiently wide for all practical purposes. The average rise and fall of the tide at the mouth of this river is 16 feet, as laid down by the surveys, making a depth of 31 feet, without any further improvement, at high water. I should say the spring tides, which occur at the full and new of the moon, rise sometimes as much as 21 feet, but the average rise and fall of the tide is 16 feet. This river, from its mouth up to and beyond the point where the canal enters into it, has a depth of 15 and 18 feet, and in parts as high as 25 feet at low water, giving also at high water from 31 to 41 feet without any further improvement.

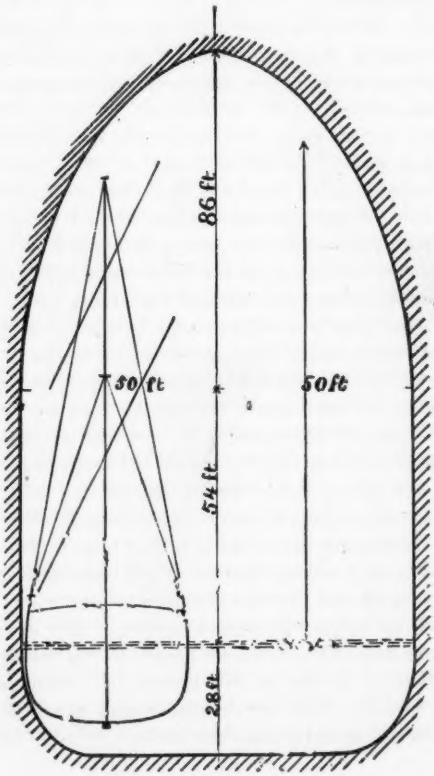
Judge Daly: Does that extend as far as the tide extends?

Mr. Shelbourne: No, sir; not as far as the tide reaches. You will see that the river makes a large but sudden and very closely returning bend here where the canal would enter it. The distance from this bend and the canal cutting to the mouth of the river is six miles, and it is for that distance that I speak when I say that the survey shows there is from 15 to 25 feet of water in the river at low water. The tide extends up this river, as the river runs, for a distance of 27 miles; but as you come up around this great bend where the canal enters the river from the northward, the river has its direction quite from the eastward and away from the line of the canal, so that you see, as the canal enters the river comparatively near its mouth and a long distance below the head of tidal action, any freshets in the upper reaches of this river cannot materially affect its level where the canal enters it. As you pass up the river from this great bend, its bed rises more rapidly until you arrive at the head of the tide—that is to say, that the river at the head of the tide would have an elevation of 16 feet above the river at its mouth in the bay of Panama, and the tide would influence the river up to that elevation, or, more correctly speaking, to a point where the ordinary surface of the river is elevated 16 feet above the surface of low water in the bay of Panama, a distance of about 27 miles. The head of the tide water in this little river, the Mamoni, closely adjacent to the line of the canal, is in a direct line from the great bend where the canal enters the Bayano, a distance of four and one-sixth miles; so that it is apparent that the depth of open cutting in the canal for this distance will vary only up to

16 feet above low water in the Bay of Panama, and from the head of tide in the Mamoni to the base of the mountain, where the tunnel would commence on the Pacific side, the elevation above low water would vary from 16 feet to 75 feet close up to the base of the ridge. The exact length of cutting from an elevation of 75 feet to that of 190 feet I have not been able to determine from the data I have had before me, but I should say less than one mile.

It will be observed that that part of the Bayano river to be utilized in connection with the canal has a width of nearly half a mile for one-third of the distance from its mouth.

Now, in regard to the tunnel and its proposed width and height. I have had a drawing made which will represent to you the section of the tunnel :



There have been various widths proposed for it, from 60 to 80 feet. Considering that it might be desirable that the largest vessels now afloat should pass each other within the tunnel—one going in one direction and the other in the opposite direction—and considering the progressive size of the vessels of the future, I have made this tunnel 100 feet wide at the surface of the water. It is also 100 feet wide at a depth of about 14 feet below the surface of the water, and to a height of 54 feet above it. Angles are avoided in the bottom of this tunnel, and the sides are seen to curve inward towards the floor, leaving a convenient fillet of rock in the corners. The height of the tunnel altogether, from the bottom to the top, is proposed to be 168 feet, with a depth of water of 28 feet. The springing of the arch is to begin at 54 feet above the surface of the water, and continue thence a further perpendicular height of 86 feet to the crown—making the latter point 140 feet above the surface of the water.

The drawing shows, in its left-hand section, a representation of the ship *James Nesmith*, a sailing vessel of 2,000 tons. The position of her topmast-head is shown when the side of the vessel is against the side of the tunnel. I have shown it in that way in order to answer the objection of those who argue that a vessel coming in contact with one side of the tunnel would injure its masts, yards and rigging against the decline of the tunnel arch. The yards of the vessel are shown cock-billed—that is, having one end of them brought downward on an inclination as shown in the figure. Both ends, therefore, of the yards are brought within the perpendiculars of the sides of the vessel. It will be seen by this drawing that, when the side of that vessel is against the side of the tunnel, the topmast-head will not touch the arch—it comes, at least, 10 feet from the decline of the arch. The width of this ship is 41½ feet. The figure shows the space between the central line of the tunnel and the body of the ship when she is placed next to the side of the tunnel; consequently, two such ships might pass each other in this tunnel, leaving a space of 17 feet between them.

The arrow-head in the right-hand section of the drawing shows the relative position of the topmast-heads of the steamers *City of Chester* and *City of Berlin*, of the Inman line, when passing each other in this tunnel. This arrow-head shows where the topmast-head of each vessel would come—the one on one side of the tunnel

and the other on the opposite side—with reference both to the central line of the tunnel and the declines of its arch. I am told that the height of the topmasts of these steamers equals those of any now afloat. You see that the clear distance, sidewise, to the arch is about 8 feet; while, if one of these vessels were passing along in the central line of the tunnel, the vertical clearance would be more than 22 feet. I should say, at this point, that it is proposed to have longitudinal fenders fastened against the sides of the tunnel, of heavy timber, so that a vessel passing through it will never come in contact with the rock nor any of its roughness.

Again, sailing vessels in passing through the tunnel will always be in charge of a tug, alongside, and the tug being the lowest by far, with its smoke-stack and rigging, will take its position next to the side of the tunnel, keeping the vessel as near as possible in the central line of the passage. A steamer in transit can keep its direction and position with the greatest facility, for the water in this tunnel will be always quiescent.

In the work of excavating this tunnel it is proposed to begin at the top and excavate first a top section or heading of the main tunnel. This heading, or preliminary tunnel, as I shall call it, will have a vertical section of about 40 square yards, and, conforming in its arch with the arch of the main tunnel, will have its floor 15 feet below its crown and be about 30 feet in width; so that, at the sides of this preliminary tunnel, its roof would be 7 to 9 feet above its floor. If a section of 40 square yards be assumed for this excavation, a length of seven miles would give 492,800 cubic yards. Of course this preliminary tunnel is commenced upon each end—giving, so far, two working faces. If shafts are deemed desirable to expedite the work, it is designed to provide for three shafts, located at the most feasible points on the top of the mountain, and sunk to the level of the floor of the preliminary tunnel, and that would give us eight working faces altogether, if such rapidity of operation should be found necessary. It may be observed, here, that the St. Gothard tunnel is being excavated without shafts, a length of nine and one-quarter miles, and the whole time is a little more than seven years.

The cost of this preliminary tunnel has been placed at $10 a cubic yard, and would amount to $4,928,000. When the work I have just named is completed, all the tunneling work, which it is

proper to name as such, is done. The rest is to be classed as work of another character.

Now, in regard to the price of tunneling work. A committee of the Paris Congress put upon the excavation of this tunnel upon the San Blas route, and, in fact, upon all the routes where tunneling was required, the greatest price that had been paid for the excavation of tunnels when they were excavated by hand-drilling and the explosive was gunpowder; and, more than this, they estimated the whole immense excavation, all of it, at the price for driving a small tunnel or heading, so that at $10 per cubic yard for tunnel, the San Blas canal, with 20,727,715 cubic yards of what the committee would call tunnel rock, would really amount to the total sum they named—somewhere about two hundred and sixty millions of dollars. This will show us how hasty and superficial were the calculations of the majority of those members of the committee having this subject in hand. Louis Favre, the contractor for the St. Gothard tunnel, did not place such figures upon the San Blas tunnel, for he made the cost at less than one hundred millions of dollars while estimating for a length of about nine miles.

Now, let us see how the question stands. The contract price for the Hoosac tunnel in 1869, for the entire excavation of the eastern section, was $11 per cubic yard; that contract was made in December, 1869, before the active era of nitro-glycerine, or dynamite, which is a modified form of the same substance, and before the use of machine drills in that tunnel, as it stood from the hands of previous operators. It was only after Mr. Shanly had got fairly at work under his contract that he introduced the Burleigh drill; and they kept perfecting their machinery from month to month and from year to year. Mr. Mowbray in 1869 was eagerly at work trying to perfect nitro-glycerine, so as to give the best results and make the explosive the least dangerous. Here, then, and in this condition of the art in 1869, with its inflated prices and gold premiums, there was a contractor who undertook to make a contractor's profit out of a small railroad tunnel at $11 per cubic yard.

The contract for the St. Gothard tunnel was made August 7th, 1872, and the contract price for the excavation of the tunnel amounts per cubic yard in our currency to $6.72. Here was another contractor who, thus early in the art, could find a contractor's profit in such a small tunnel at such low figures; but his mind was open

to the future of his work, in the midst of the success of which he laid down his life. The vertical section of the St. Gothard tunnel is about 72 square yards.

Again, as to rapidity of execution in tunneling work: In 1863 the progress made in the Mount Cenis tunnel with hand-drilling and powder as an explosive was an average of a foot and a half per day. After they had commenced to introduce power drilling and the Sommeiller machine, the progress they made was three times greater—that was four and a half feet per day. When Louis Favre took the contract for the St. Gothard tunnel in 1872, the Hoosac tunnel was then in the rush of its progress under Mr. Shanly, Shanly completed his contract and made a provisional settlement December 22, 1874, and the tunnel was put to use the following year. Mr. Shanly said in 1874 of the machine drills used: "The use of the machine drills saved about two-thirds of the expense of drilling. The expense of labor would have been, I think, fully three times the cost of machine drilling. To have done this work by hand-drilling would have taken, I should estimate, not less than twelve years." This was the work, even at that time, accomplished in less than five years.

In the St. Gothard tunnel, from 1875 to 1877, with the greater perfection of explosives—for they had come to use nitro-glycerine by mixing it with an earthy material, making a compound consisting of seventy-five per cent. of nitro-glycerine and twenty-five per cent. of the adulterant and calling it dynamite, from a Greek word signifying power, and which is the standard explosive they now use—in 1875 to 1877, I say, with better explosives and improved drills, they made a progress of five to one; that is to say, they excavated their tunnel about five times as fast as was the progress in the Mount Cenis tunnel in 1863 by hand-drilling. Now, in the years 1878 and 1879, by the general improvement of the whole administration in the St. Gothard tunnel, they are making a progress of more than eight to one, or about 13 feet per day, through granitic gneiss, in a single heading. So that now, if they can excavate and remove rock from a tunnel eight times faster than they could fifteen years ago, you may readily see how much easier—how much more feasible—a tunnel has become to-day, on an Isthmus canal route, than at the time, in 1870, when the surveys of Selfridge were made. Indeed these naval officers, in their sphere of action, were ignorant

of and had not conceived as possible these strides of inventive and engineering skill. How much value then—and I appeal to the judgment of each one of you—how much value must we now place upon the reports and opinions of these naval officers as to the comparative merits of a route, with a tunnel or without one, at the time their surveys were made?

The object of these surveys by the government was to find a low pass through the Cordilleras upon which they could construct a canal; and one of the conditions of the problem was that they should find a sufficient water supply to furnish the locks of the canal. They had hardly conceived the idea of making a tunnel; and if they were to have a tunnel as Selfridge proposed for the Napipi route, it was to be a short one, and only an absolutely necessary adjunct to permit them to realize the other conditions of water supply and a lock route through as low an elevation as it was possible to find.

I have a letter from Mr. W. Shanly, dated in September, in which he says that he would be willing to take the contract to drive the preliminary tunnel I have explained to you, for the San Blas route, for $9 a cubic yard. I have placed the cost at $10. Of course Mr. Shanly's price provides for a contractor's profit above the real cost of the work.

Now, in regard to the remainder of the work. You will see that when this preliminary tunnel has been excavated as represented by the section I have named, that only a very small percentage of the excavation has been accomplished. Engineers agree—Mr. Shanly has so stated, and Mr. Latrobe, and, I believe, Mr. McAlpine—and indeed it is clear to the mind of an engineer that when the preliminary tunnel is once driven the remainder of the work becomes nothing more than open cut work, with the extra advantage that you have the protection of a roof over you, so that the work with electric light can be carried on twenty-four hours a day the year round, without exposure to the vicissitudes of the weather, or the malarial atmosphere of swamps and vegetable decay.

Now, if the estimates for open cut rock upon the Nicaragua route, as its advocates have placed them, should be applied to this tunnel open cut work here, the result would be that the whole cost of the tunnel would be only $30,837,644, that is allowing $10 per cubic yard for the preliminary tunnel, and calculating the remainder at $1.25 per cubic yard. But I have endeavored to show on several

occasions that the estimates of the advocates of the Nicaragua route for their open cut rock work are entirely inadequate. I have more than doubled their price for this class of work, and placed the excavation of the remaining portion of this ship canal through the mountain at $3 per cubic yard; so that the cost of this great tunnel—I mean the excavation of it—would be something like $65,000,000. I have the exact figures somewhere, but not just now at my command. If, however, sixty feet should be thought wide enough for the passage through the mountain, the cost would be reduced to about $40,000,000.

Every one who has objected to a canal route by way of San Blas has brought his first and chief objection and his last and reiterated objection to bear upon this tunnel: I suppose because all the other features of this route, except what lay in their ignorance, were admirable and pleasing to their minds, and the tunnel was the one thing to decry. They say that it is impossible to calculate its cost, and they assume to fear that the mountain would tumble in on the workmen, as if it were a quicksand, or that everything will be drowned out of it, as though it were a cloud of waterspouts. I have been careful in placing the figures upon this work, and I think they will cover the maximum. If the open cut work upon so large a scale as this could be done for $1.50 or $1.25 per cubic yard, you see that the whole cost would be reduced more than one-half the highest figures I have given; but I prefer to be safe in this respect.

After the preliminary tunnel has been driven into the mountain on either side for a certain distance, a multitude of workmen is placed upon this open cut excavation, and the tunnel is enlarged from the top downward in benches of rock and in convenient sections, always providing a depression for the drainage of infiltration. A track is laid in the tunnel and the debris is railroaded out on flats and dumped at either side of the proposed canal upon the low ground adjacent to the sea, and perhaps extending a certain distance into the harbor of Mandinga, and widening out on either side so as to form a convenient mouth for the canal.

But the great question has been whether the rock in the line of this tunnel would be homogeneous enough so that a natural arch would be self-sustaining—whether, in fact, the rock there was not entirely disintegrated and full of broken pieces, seams, cavities and cracks, so that, as we attempt to go through it, as one person ex-

pressed it to me, it would be like going through a mountain of cobble-stones. Indeed, some of the objectors seem to have agitated their minds into a lather of swollen apprehension on this subject.

It is sufficient to say that, through the base of the Cordillera upon this route, the rock is largely, if not entirely, granite rock.

Judge DALY: Is that the report of Mr. Kelley's engineers, or is it the surface indications?

Mr. SHELBOURNE: That is not the report of Mr. Kelley's engineers, because there were no geologists with Mr. Kelley's engineers; they made an engineer's survey. But this section of the isthmus has been examined, embracing both the San Blas route and the coast and interior further south at Caledonia bay, by J. Petigru Carson, mineralogist, and E. W. Bowditch, assistant mineralogist, of the expedition of 1870. Besides, the geology of the whole lower isthmus, embracing the Gulf of Uraba and the Atrato region, on the Atlantic side, and also the Pacific side, including the Tuyra region to the dividing ridge, and the coast from Limon Bay to Panama, and across on the line of the railroad to Aspinwall, has been examined and carefully reported upon by Dr. A. G. Mack, of Cambridge, Mass., and the specimens he brought home are now, by permission of the Secretary of the Navy, lodged in the geological collection of the Cambridge University. We have also various information from the works of older geologists and others who have exploited these portions of the isthmus, among them being Mr. Arthur Schott, accompanying Michler's survey of the Atrato-Truando region. On the San Blas route the boulders and other loose specimens found in the beds of the rivers up their courses were examined, and also the outcrop upon their banks and upon the various ridges of the mountain; besides, immense gorges of syenite were found, one of them extending for half a mile.

There is one very important thing, then, which can be said of this section of the isthmus that cannot be said of any other portion of it through which the various proposed routes for a canal pass. It cannot be said of Panama, nor of Nicaragua. It is this: that the San Blas Cordilleras are composed, on the Atlantic side at least, and through the bases of the main ridge, of the older crystalline unstratified rocks, granite and syenite, which is a species of granite. The common granite is composed of quartz, feldspar and mica. Syenite is that species of granite in which the mica is supplanted

by hornblende. Now, these older crystalline unstratified rocks are the very oldest of all the rocks that appear upon the face of the earth. They are called primary in the books. Indeed, before any animal or vegetable life came upon the earth these rocks formed the ribs, we might say, of the continents. They are coeval with the foundations of the earth, so that we may write upon them an inscription quoted from the third canto of Dante's Inferno:

"Before me created things were none, save things eternal."

This part of the isthmus, cutting it off near to Panama on the west and north on the one side, and taking the Bay of San Miguel and the Tuyra river over the divide to the Atrato valley and the Gulf of Uraba, as the limit towards the south and east—this part of the isthmus was originally a mountainous island. The whole of the lower valley of the Atrato river is an alluvial deposit. The part of the isthmus between the Bay of San Miguel, the Tuyra river and the Atrato valley on the north, and Cupica bay on the south, was upheaved long after the bases of the San Blas Cordillera appeared. This southern region shows the later tertiary formations. The same may be said in regard to the broken region between Panama and the Bay of Colon, which shows scarcely more than a series of detached hills, irregularly placed with reference to each other, like a lot of tumbled biscuits on a tray. The waters of the Atlantic and the Pacific were, at one time, united both in the region between Panama and Colon, and between the Bay of San Miguel and the Atrato valley, which was, in early ages, a part of the Gulf of Uraba, the junction of the two oceans being in the general line of the Tuyra river. So that we have to the north of this river the foundations of the Cordilleras range and its spurs composed of the primary unstratified rocks, and to the south of it, towards Cupica bay, the volcanic rocks, belonging to a much later era, and between the two formations, rocks of what is called the transition series. Here is a general map of that part of the isthmus, which I have taken from the series accompanying Commander Selfridge's report, and is map No. 1 of that series. You will see on it the general relation of the two divisions of the Cordilleras south and north of the Tuyra river. You will see, as you pass from the Bay of San Miguel up Darien harbor and the Tuyra river, the peculiar broad pockets and connecting reaches of water made by the banks, so un-

like an ordinary river, and as you get up towards the ridge, or rather the depression or division between the two formations at the headwaters of the Tuyra, you will see how the mountainous section of the isthmus, on the north and east, is divided from that towards the southwest, so that, in a general way, they may be said to lap by each other. You see that the region at the headwaters of the Tuyra is filled also with numerous detached hills like the region at Panama, and the Rio Chucunaque, coming down from the far north and the middle of the older part of the isthmus, makes a very angular turn below Yavisa, and flows with the Tuyra towards the northwest and Darien harbor. Before the upheaval to the south, this river doubtless flowed into the passage between the two oceans, where now it makes its sudden bend to the northwest, and Darien harbor and the Bay of San Miguel are nothing more than the depression that was left after this later upheaval. In the fact of this passage here between the two oceans we may largely find the origin of the extensive alluvial deposits of the Atrato valley. The tide rising twice a day from 17 to 24 feet in the Pacific at this part of the isthmus, and scarcely 20 inches in the Gulf of Uraba on the Atlantic, the swift tidal current through the passage, always in one direction, must have carried immense quantities of alluvium with it. To the same cause I attribute the large swamp area adjacent to Colon in the Panama region.

Here, then, are two facts which mutually support each other. First, the fact that granite and syenite, both in mass and as boulders, are found *only* in the region of San Blas, and south towards the region of the Upper Tuyra, and nowhere else on the whole isthmus, from above Nicaragua southward, proves the fact that the transition rocks exist somewhere between the old and the new—and sure enough, the fact that the formations found in the Upper Tuyra region are of this series, and reveal their fossilliferous character by their marine shells, proves both the fact that the waters of the two oceans once joined in this region, and the fact of the older formations on the one side and the later on the other. So that, when the upheaval took place in the later tertiary period which closed this passage, these broken hills which were thrown up here partook of the character of each adjacent formation.

Again, as to the evidences of the character of the San Blas Cordillera, on the Panama side. We see that the continuous ranges of

these Cordillera, running towards the west, terminate abruptly here, and are succeeded by a series of lower detatched hills, as I have said. None of these hills are of a granitic character, but are the result of volcanic eruption. The fact, however, appears that in the playas of the Chagres river at Mamey and at Matachin, we find the older crystalline pebbles, the granite and the syenite. Now, the Chagres has its sources in the high elevated San Blas Cordillera, from which these pebbles have been driven by the river current; but no pebbles whatever of a granitic character are found in the beds of the rivers coming from the opposite direction. The later eruptive origin, then, of the rocks on the Panama route, proves the fact that the Chagres river at one time found the waters of the sea at Matachin. This is also evidenced by the fact that, close to the highest ridge of this part of the isthmus, fossil corals have been found, and up the Chagres limestone deposits filled with fossil shells, while in numberless places along the railroad the strata of the volcanic tuffs are apparent, and quarries of it for the use of the railroad have been opened containing particles of gold belched out, and fallen into the sea or strait with the volcanic cinder.

Following the isthmus northward to Nicaragua, we will find the rock to be of the same general character as at Panama. The geologist connected with the survey of the Nicaragua route says the rock they found there was mostly of the later tertiary period, volcanic, basaltic. They found some crystalline limestone, which belonged to the group of sedimentary deposit, and was slowly upheaved from the sea. I think, therefore, upon the evidence presented, the distincive fact appears that of all this region of the isthmus, commencing at Uraba, and away to Nicaragua, the only part of it where the primary formation appears—the oldest of all—the unstratified rocks, the granite and the syenite, is in the range of the San Blas Cordillera. This fact, then, of the character of the rock to be found on the line of the San Blas route, will give us an indication of the work before us in piercing a tunnel, and the homogeneity and stability of the material. Further than that, we cannot say. Nobody has bored into the heart of that mountain to determine just what may be its character and to what extent we may depend upon the uniformity and closeness of its structure. It may be, and the probabilities are, that the most of the rock found in that tunnel will be sufficiently homogeneous to be self-sustaining.

The general reputation of granitic rock for continuity and closeness is pretty well sustained by the fact that it usually excludes water infiltration. Of 2,000 metres of granitic gneiss, of a single stratification, in the St. Gothard tunnel, the work was quite dry.

But if, on the other hand, we admit the probability of finding demoralized rock, we know the proportion of it in the tunnels that have been excavated. Let us take at random the Hoosac tunnel, as the nearest and most prominent example. Mr. Shanly told me recently that they found various characters of rock there, some granitic rock, but largely mica schists and other schistose formations, and of 25,000 feet in length, which he excavated under his contract, only 4,000 feet needed any arching of masonry. Here you find a tunnel made with a very flat arch—a tunnel in a very variable climate, the temperature now up to 100, now down to zero and below, freezing the water in the crevices. Upon the isthmus we have a nearly uniform temperature of 70 to 85 and perhaps 90 degrees. There would be no snow—no freezing. The arch would be a gothic arch, as shown here in the figure. If we should find as great a proportion of the length of the tunnel that would need arching as they found in the Hoosac tunnel, which would be in this case a trifle more than one mile, it is proposed that an arch be constructed resting upon abutments in the natural rock sides of the tunnel, 50 feet on the curve of the arch below its crown, which would make each segment or rib of the arch a length of 50 feet. Now, to construct that arch with these ribs made of cast iron, would give about seventy-five per cent. more strength, with only about one-third of the dead weight of an arch made of the best of stone, as granite, five feet in thickness over that whole space. A section of one of those ribs may be roughly represented by a plain letter T, with the head stroke shortened and the body stroke lengthened. The width of the head, which would be on the greater or outward curve, next to the rock, would be one foot, and the depth of the remainder of the section of the rib would be two and one-half feet at the crown of the arch, and three and one-half feet where it rests upon the abutment. A shoe or bearing plate would be cast on either end, the full width of the head and depth of the section, the shoe, on the lower end, resting on the abutment, and the bearing-plate on the upper end coming in contact with that of its fellow at the crown. As these ribs would be placed close together, each successive pair in contact with the preceding, it

will be seen that each foot in length of the portion of the tunnel arched in this way would be represented by a pair of these ribs. The metal in the ribs would be of a uniform thickness of two inches, with a fillet at the junction of the head with the body. But objectors will say that the iron will easily perish with rust, and so crumble away. Now, we know that iron rusts in proportion to its purity. Cast iron rusts very much more slowly than wrought iron, and wrought iron chemically pure rusts most freely of all. But these ribs or segments are so devised that neither a drill or a chisel will touch them; and by lining or sifting the mould with the elements of glass, or the powder of ground glass of the commonest description, you will cast upon those ribs a coat of glaze, so that they would be protected for an indefinite period of time from rust. These segments of the arching being placed close to each other, side by side, the backs of the whole, when in position, would represent a continuous arch-roof of iron, and the space between this roof and the irregular rock above, perhaps from three inches to a foot, would be filled with concrete. The arch thus constructed could be rapidly and easily put in position, and the cost would be less than one-half that of a granite arch of the thickness I have named. It would be very difficult to put up large granite blocks in an arch of that character, and it would involve a great deal of work, and be very slow of accomplishment. Such an arch of iron has therefore been proposed, if it should be found that an artificial arch would be necessary; and if so, our present examples teach us that it would only be required, in this tunnel, for about the length of a mile.

I believe I have spoken of all the points in the excavation of this tunnel, except this matter of infiltration. It will be seen that in the excavation of the preliminary tunnel, whose floor would be 175 feet of elevation above the sea, the drainage of the infiltration could be made perfect at each end; and only in case shafts are sunk from the top of the mountain to expedite the work, would pumping be needed, and then only in the shafts. While there are peaks of the Cordilleras which rise very high above the general plateau of the elevation, there may be points selected in this plateau where these shafts can be sunk at perhaps an average of 500 to 600 feet above the level of the sea; so that the shafts would be of that depth minus 175, the depth from the floor of the preliminary tunnel to the sea level, or altogether a depth of the shafts of from 325 to 425 feet. In the

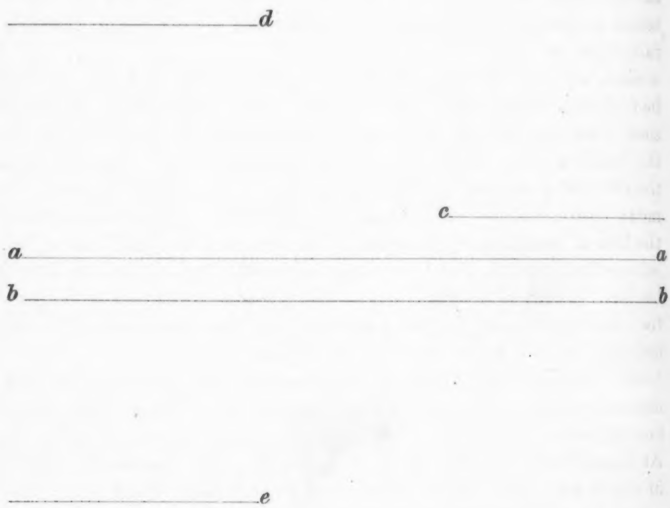
Hoosac tunnel they pumped up the water of infiltration for the whole working central section through a shaft of 1,030 feet deep. They had shafts in the Sutro tunnel of 800 or 900 feet in depth—twice and three times the depth proposed here at San Blas. But, leaving out of view the question of the shafts, this preliminary tunnel can be perfectly drained from each end, while the work is in progress, without a gallon of pumping, and the drainage could be equally perfect while driving through the whole depth of the tunnel open cut work, until you get down to the level of the sea ; and then first, of all the work, would the water of infiltration need to be removed by pumping ; but that would only be for the depth of the excavation below the level of the sea, varying from nothing to a depth of 28 feet.

Now, where you have a depth of 1,100 or 1,200 to 2,000 or 3,000 feet, from which to pump water, it is a different problem altogether from that where you have only to pump it up an ordinary depth of 28 feet. The large centrifugal pumps, now in common use, would throw almost a Niagara of water up from so small a depth into sluices which would carry it off. By excavating this portion of the tunnel in consecutive sections of half a mile, Mr. Shanley has stated, and I perfectly agree with him, that there would be no difficulty whatever, with ordinary pumps, in easily keeping the water free from this excavation while it is being made to the depth of 28 feet below the level of the sea.

Of course the excavation of the five miles of the canal between the tunnel and the harbor of Mandinga would be done in the lower portion next to the harbor by dredging machines, thus bringing the navigation up to within about two miles of the mouth of the tunnel, and this two miles being excavated down nearly to the sea level, a bulkhead of rock would be left towards the sea end of it, perhaps 20 feet thick, while the rest of it is being excavated below the sea. The same condition, as to open-cut work, drainage and pumping and method of procedure, would obtain upon the Pacific side as upon the Atlantic; a considerable portion of it would be done by dredging machines, commencing at the debouchement of the canal into the river Bayano.

Now, in regard to the tide levels of the two oceans, and in regard to the tide-lock that would be required for this canal. As I have said, the mean rise and fall of the tide in the harbor of Mandinga,

upon the Atlantic side, is eight-tenths of a foot. Now, that being the mean, the extreme would be somewhere about two feet at spring tides, and with the wind blowing from a direction to pile up the water in the harbor, or the reverse. So that, in order to keep a depth of water in the canal of 28 feet at all times, without a gate or any artificial structure upon the Atlantic side, it would be necessary to make the level of the water in the canal to correspond with the lowest low water level in the Gulf of San Blas. The conditions of the whole case will be readily represented by some parallel lines shown on this diagram:



The line *a a* will represent the level of half-tide, which is the same in the two oceans. Of course, it is readily understood that if there were no tide in the Atlantic, and no tide in the Pacific, and the waters of the two oceans rested quietly without tidal movement the same as in a small lake or pond, they would be at the same general level in both oceans, due to the law of terrestrial gravity ; and that level would be the level of half-tide as things at present exist, and would be represented by the line *a a*. Although it is not

the practice in popular usage, for the purposes of this illustration we will say, when the tide rises it is above *a a*, and when it falls it is below *a a*. Taking the distance between the lines *a* and *b* and between the lines *a* and *c* to be in each case one foot, *c* would represent the maximum rise of the tide and *b* the maximum fall of the tide at the Atlantic end of the canal; the mean rise of four-tenths of a foot above *a*, and the mean fall of four-tenths of a foot below *a*, coming of course between the lines *b* and *c*, it is not necessary for our purpose to represent. Now, instead of taking the half-tide level *a a* as the proposed level of the water in the canal, we take the line *b b* for that level ; because, if *a a* were taken as the level of the water in the canal, when the tide had fallen in the Gulf of San Blas to the line *b*, the water in the canal would run towards the gulf, for the water in the gulf would then be one foot lower then the assumed level of the canal. To avoid such a state of things, therefore, it is proposed to make the level of the water in the canal correspond with the level of lowest water in the Gulf of San Blas, that is, the line *b b*. On the Pacific side the mean rise and fall of the tide is 16 feet, that is, eight feet rise above the line *a*, which is represented by the line *d*, and eight feet of fall below the line *a*, which is represented by the line *e*. But the line *b* has been assumed as the level of the water in the canal, and therefore, in the ordinary movements of the tides on the Pacific, the tide-lock at that end of the canal would, a part of the time, lock upwards from *b* to *d*, a height of nine feet, and the remainder of the time lock downwards from *b* to *e*, a descent of seven feet, these conditions of lockage alternating as the tide should be high or low in the Pacific. At times, however, the tide rises and falls in the Pacific at this part of the coast more than 16 feet, in which case the lockage either way would be correspondingly increased.

The tide lock upon the Pacific end of this canal would be constructed of a length of 1,125 feet and a breadth of 100 feet ; the gates, instead of being double at either end of this lock, would be single, and would be sliding instead of folding gates, and move on rollers, the advanced end of the gate moving into a recess across the opening of the lock, so that the pressure from either side will not disturb it from its position as the tide may be high or low. These gates need not be tightly fitting, for, since the two oceans

are the water supply, the escape of more or less water in the one direction or the other is of no consequence.

At the middle division of this lock there would be a slight contraction in its width, and here would be another gate of the same construction, which would ordinarily be left open. Now, you may conceive that occasion may arise for the removal of one of these gates for ordinary repairs; or one of them may become damaged by accident, in which case you always have a tide-lock between the other two, of a length of 560 feet, and either one of the three may at any time be regarded as an extra gate, and be removed for repairs. It will be observed, that a tide-lock as here proposed to be constructed and used, is not at all comparable with the detail lockage and conservation of water supply, as contemplated on the Nicaragua route. There the gates must be close fitting, to save their lockage supply, and double and mitreing to each other, that they may be close fitting, and the locks made as small as practicable, and locking only one vessel at a time, all for the purpose of saving the water. In our tide-lock, however, prodigality is not waste, for what escapes from the Pacific goes to the Atlantic, and *vice versa;* and, until both these oceans run dry, we shall always have enough. So that, in our tide-lock of the length and width proposed, six ships of 1,000 tons each can be passed through in one lockage.

To fill and deplete this tide-lock, it is proposed that the main gates shall have subsidiary gates arranged within them, to be raised or lowered, so as to open and close a passage through the main gates 60 feet wide by six feet high, located below the level of low water in the gate next to the Pacific, and at any convenient distance below the water in the canal at the opposite end of the lock. The time required to fill the entire undivided lock to a level of nine feet would be less than three minutes.

It hardly seems to me that the question of calms in the Bay of Panama needs any more explanation than I have already given it, both here and elsewhere. But I want to say that this subject has been investigated and reported upon, under the concurrent written instructions of Commander Selfridge and Admiral Ammen, then in the Navy Department, by Lieutenant Frederick Collins, who was attached to Selfridge's expedition, and who was ordered to inquire and report upon the winds and tides of the Pacific ocean, with particular reference to the functions of a canal constructed on

the Atrato-Napipi route. This is the gallant Collins who, as we all know, never stood up against the flag of his country, nor forswore the oath which made him one of the trusted protectors of our constitutional Union and our civil liberties. In his investigations he had occasion to make some observations and pass some criticisms upon that other former officer of our Navy, Lieutenant Maury, and to point out a great discrepancy of view between the well-known authority, Kerhallet, and his own countryman with reference to the general subject of his inquiry. Now, Lieut. Maury had the whole Pacific ocean for the subject of his inquiry, away across to the China seas, and so did Lieut. Collins, and yet, while he was to make all the results of his work to converge on the edge of the Bay of Panama, at the Pacific end of the Atrato-Napipi route, he does not even once, with reference to calms, mention the Bay of Panama in his report. Was this gallant officer overawed in his judgment by the dominant officialism of a then different interest, or did he really forget to point out to his superior and directing officers the one important fact they should have known as against that route, if the objection of the calms which the Nicaragua advocates now spread with so much *wind* of talk over the whole Bay of Panama were really a valid one? But leaving them to their efforts, I have to say there are, generally speaking, up and down this Pacific coast of North and South America what are called coast trades, or, localized, the monsoons of Mexico. When the sun is going south these winds blow towards the south. They go with the sun. When the sun is coming north, they blow towards the north. It is 300 miles away to the westward from the general line of this coast that the great system of winds of the Pacific are located and extend across to the China seas. It is true there is located in the general system of the winds of the Pacific a belt across the Pacific near the equator, called the belt of the "doldrums," but this word does not mean calms by any interpetation, but rather light and variable winds, with storms of wind and rain and squalls and calms thrown in; or, as the sailors call it, "dusty weather." But what has this to do with the coast breezes, which by common report we are told exist in the tropics? And yet, if the logic of the objectors should hit the real fact, instead of an assumed one, it would prove too much; for a vessel going through a canal by the Nicaragua route, and destined to any of the ports of the South Pacific, Australia, New Zealand, the west coast of South America, and the numerous islands south of the

equator, would have to pass, in the voyage, through that whole belt of "calms" which they use so diligently to give size to their statements when objections to any more southern route than their own are in place to be heard.

But they are careful to locate these "calms" precisely in the Bay of Panama. They say a vessel would be likely to be held in this region for perhaps three months, not able to get in, or once in, not able to get out. Surely, in their view, it must have been here where Coleridge's Ancient Mariner conceived the situation of a "painted ship on a painted ocean."

Now, I have the practical observations and experience of sea captains in the California trade, who have gone into the bay of Panama time and again. I have the statement of the President of the Maritime Association of the Port of New York, who sent the first vessel to California, with supplies in the early days of its *El Dorado*—whose firm in the height of this California trade sent as many as 125 to 130 vessels with various materials in a single year to Aspinwall and Panama, the one and the other, and that they regarded Panama as favorably for access and sailing convenience as any port on the coast. That, then, is the practical statement of the case.

Judge DALY: Are there any earthquake difficulties on the San Blas route, so far as known?

Major SHELBOURNE: There are none, so far as we know, from the earliest records. We have, on the contrary, the geological character of this portion of the isthmus, and the notable fact that in all this region of the older rocks we have not a sign of a crater, living or dead. Of course I do not wish to be understood to mix up earthquakes and volcanoes as necessarily coexistent in the same localities; but, while earthquakes are due to the mighty pent-up forces under the crust of the earth out of their equilibrium, and seeking relief, the volcanoes are the local, the open and the speaking mouths of the earthquake energies.

Judge DALY: About how far does the volcanic rock come down upon the isthmus?

Major SHELBOURNE: It comes down on the north to the Panama region; and, as I said, this portion of the isthmus, from Panama up to, and I know not how far beyond, Nicaragua, is entirely of a later formation—a secondary sedimentary, and a tertiary volcanic origin. There is also basaltic or volcanic rock in the San Blas region, but it

forms the caps and the overcoat of the Cordillera, so to speak, while the bases of the mountain are granitic. As to the activity of earthquakes in the region towards Nicaragua, I was informed after the last meeting in this room, a week ago, by one of the gentlemen present—I think the one who spoke last, and was called upon by Mr. Menocal to give some idea of prices of excavation in Nicaragua, because he had been connected with engineering work in Costa Rica —that during the past year advices had been received that in one of the towns of Costa Rica, which, as you know, adjoins Nicaragua, a cathedral had been rent and very much damaged by an earthquake. Now, in the San Blas region of the isthmus, the region of the very earliest rock formation, as I have said, so many ages have elapsed since it was the scene of active volcanic energy, that nowhere are there any traces even of extinct craters to be found. But if you go either north or south, on the one hand only as far as Mexico, and on the other to the Colombian territory itself, at the very northwest part of the South American continent, we find regions of active volcanic action, an example of which may be found in the Colombian State of Tolima, where there is an active volcano identical in name with the State. In fact, geologists tell us that under the South American region of the Andes, from Colombia on the north to Chili or beyond on the south, there are whole lakes of melted lava, involving regions of hundreds of square miles in extent. It is a well established fact that earthquakes have their origin and are most frequent and violent in active volcanic regions. Now, the fact that from Panama south to the Gulf of Uraba no indications of even extinct craters exist, and nothing more than the very slightest sensations of earthquakes have been felt, and no damage done discoverable from the time of the earliest records, points sufficiently to the conclusion that active volcanic and subterranean action have entirely ceased in this part of the isthmus since remote ages. In like manner we find in other parts of the earth the same conditions to exist, for ancient volcanic mountains are met with in Hungary and in central France, of whose eruptions no record exists, and many parts of the Rocky mountains give evidence of the same character. Fisher's Peak in Arkansas is also said to be an extinct volcano. In 1863, the best authorities enumerated eighteen active volcanoes in Central America. As none of these are to be found in the Columbian part of the isthmus, they must be credited to the more northern countries, of which Nicaragua and Honduras

are the central states. Within the past month a map has been published, the data of which is the work of Dr. Kuyper of Holland, giving the location of thirty-eight volcanoes between the southern bounds of Costa Rica and the proposed Tehuantepec route on the north, of which number ten are found in Nicaragua. It is not stated how many of these are active, and only the figures of 1863, which I have given, will enable you to form an opinion.

It seems, moreover, natural in science that in this narrow San Blas region of the isthmus, which was slowly upheaved ages and ages before the more northern region was produced, that volcanic action should be now entirely dead, and as to earthquakes having their origin in regions more or less remote, the pent-up forces under the crust of the earth seeking a vent would be found to demonstrate their energies, according to science, in the line of least resistance, instead of up through a narrow ridge of high mountains with deep ocean beds on either side. It would appear, therefore, from all the considerations adduced, that we are entitled to expect entire safety for a tunnel pierced through the San Blas Cordillera.

It has been suggested by some of the friends of this route that the canal ought not to be taken into the Bayano river at all, but to make a separate cut for it along the valley of the river into the bay of Panama, with the object of avoiding the continual filling up of the deepened river and bar at its mouth by the material brought down from its head waters. That is merely a question of choice based upon cost; the bottom of this river is largely mud and easily excavated. It would cost about five million dollars extra to cut the canal outside of the river and make a proper mouth for it in the bay. The interest on this sum at four per cent. would represent an annual sum of $200,000. For half this sum per annum the required depth in the six miles of the Bayano river could be constantly maintained.

Judge Daly: Can you give us some idea of the general cost before you conclude?

Major Shelbourne: I have estimated the exact cost of the tunnel, as near as may be, placing the liberal prices I have named upon it. The cost of the preliminary tunnel would amount to $4,928,000; the cost of the remaining or floor work in the tunnel, at $3 per cubic yard, comes to $62,183,145, making about $67,000,000, assuming the width to be 100 feet and the height 168 feet for the whole tunnel. In addition to the tunnel there would be 17 miles of open-cut exca-

vation, about one-half of which being of very small elevation the cutting would be light. You will observe, from the fact that no borings have been made to determine the depth through the soil to the rock, and no survey of an actual location of this line having been made, the character and depth of the open cutting at every particular point cannot now be given; but a general estimate, coming within a fair approximation, can be attained. I should say that for four miles of this work a half million dollars per mile would be a liberal estimate; for five miles of the remainder one million dollars per mile, and for the last eight miles a million and a half per mile would cover the whole cost, making the open cut work, outside of the tunnel, amount to \$19,000,000. If two million dollars are allowed for the tide-lock on the Pacific and for other minor works of artificial construction, there would still remain twelve million dollars for general administration and contingencies to bring the total cost of a canal on this route up to 100 million dollars.

Judge DALY: What was the estimated cost by way of Nicaragua?

Major SHELBOURNE: As estimated by Mr. Menocal, it was altogether, about \$66,000,000. But that was by placing a very inadequate estimate upon the work. If the prices for two items alone—the open-cut rock excavation and the submarine rock excavation—are brought up to correspond with the prices I have placed for the San Blas route, his estimates would at once be increased by the large sum of \$31,000,000; that is, by estimating 14,677,386 cubic yards of open-cut rock at \$3 instead of \$1.25 and \$1.50, as he has it, and by estimating the submarine rock at \$12.50 per cubic yard, instead of \$5, the price he has assigned. Without considering any other under-estimates except these two, and adding his usual percentage for contingencies, the cost of the Nicaragua route would mount up to \$104,421,790.

It will be seen that the San Blas route is free entirely from the troublesome question of a large surface drainage and intersecting rivers. Cut through at one level, from tide-water to tide-water, it takes only the parallel valleys of the little Mamoni, near its mouth, and the still smaller Vercalagua, on the Atlantic side.

For access, this route admits of ship navigation to within five miles of the mouth of the tunnel on the Atlantic side, at the very outset of the work, and within seven miles of the tunnel on the Pacific side—permitting the unloading of machinery from shipboard within easy distance of the main excavation.

The whole work, with the progress being made elsewhere in rock excavation, could be executed probably in six and certainly within eight years. The preliminary tunnel could be completed in four years; but, from the outset, the open-cut work could be in free progress, and the floor excavation downward from the preliminary tunnel could follow closely upon the advancing heading. While the exposure of the entire work on the Nicaragua route would limit the operations to the daytime, and the work be suspended for times at least during the wet season, from rains above and floods beneath, the tunnel excavation at San Blas could proceed the year round, both night and day. For this reason 21 millions of cubic yards of floor rock could be excavated under the roof of the San Blas tunnel in less running time than the 15 million cubic yards of exposed open-cut rock on the route through Nicaragua.

It remains only to speak of maintenance and cost of towage. The advocates of the Nicaragua scheme have assigned a sum of a million and a half to two million dollars per year for the maintenance and operation of a canal by that route. Its total length is more than six times as great as the route by San Blas, and because of its multitude of locks and other artificial constructions, and the fact that its promoters are not noted for excessive figures—if we take the larger sum as the approximate one, and reckon a pro rata expense for this natural, rock-walled passage at San Blas—there will be held of its income, each year, an advantage over the Nicaragua route of more than a million and a half to the credit of its dividends.

And we mark the towage at the same proportion—five dollars of every six saved to the vessel, or, with no difference to its owner, added to the profits of the scheme. Would you not say that in these last items alone it would be easy to determine a balance of reasons sufficient to move the money circles of the world to the route they should choose?

I have thus presented the most important features of construction and advantage of the shortest of all possible routes through the isthmus, and I have long had the conviction that it will eventually share alike the earnest attention and favor of men of science and capital and commerce.

Judge Daly spoke of the address of Major Shelbourne as being a clear, precise and practical exposition of the subject, founded upon facts and free from speculation—a communication of great importance.—The meeting then adjourned.

THE INTEROCEANIC SHIP CANAL.

Special Meeting of the American Geographical Society, held at its rooms, No. 11 West 29th Street, New York, on the evening of Monday, December 29, 1879.

There were present—Chief Justice Daly, Mr. Frederick M. Kelley, Mr. H. H. Hall, Mr. John E. Body, Major S. F. Shelbourne, Colonel D. Woodruff, U. S. A., Elial F. Hall, Henry Morrison, Jess Young, Dr. St. John of Cleveland, Ohio, General G. W. Cullum, U. S. A., Alexander Lang, Chief Justice Curtis, General Egbert L. Viele, Mr. N. P. Bailey, Captain Jenkyns C. Battersby and Mr. Octave Chanute.

Judge Daly, the President of the Society, upon calling the meeting to order, said that the last evening had been devoted exclusively to the consideration of the San Blas route ; but that the desire of the Society was that all the routes should be investigated, so far as was possible ; that it was proposed to listen this evening to Mr. Hall in an exposition of the Tehuantepec route, which had been surveyed for a railroad, and to a certain degree for the purposes of a canal. Judge Daly said he understood that measures were now being taken to build a railroad, without reference to the building of a canal, and that it was a matter of interest to know how far, for the present and for the future, a railroad would serve the general purposes of commerce, and to what extent it might dispense with the necessity for a canal; but that the general impression prevailed in this country, and throughout the commercial world, that a canal will ultimately be necessary. After alluding to the favorable geographical proximity of the proposed route to the United States, and particularly to their southern boundaries, Judge Daly introduced Mr. H. H. Hall.

Before making his remarks upon the Tehuantepec route, Mr. Hall read the following communications:

Your attention is called to the accompanying copy of a railway grant across the Isthmus of Tehuantepec, and also to the epitomized memoranda.

The grant gives authority to Edward Learned and his associates to construct

a railroad and telegraph across the Isthmus of Tehuantepec, and operate the same, for the term of ninety-nine years; and, in aid of such purpose, donates large subsidies both of land and money.

The eastern or Atlantic terminus of the road will be at the mouth of the Coatzacoalcos river, about one hundred and ten miles southeasterly from Vera Cruz; the line will run thence southwestwardly across the plains to the mountain range; thence across through the range to Chivela pass, and thence across the plains to the inland lake called the Upper Lagoon, on the Pacific coast. The length of the main line will be between 140 and 150 miles. Turnouts and sidings may make the extreme length 160 miles.

The road will traverse an exceedingly healthful and productive country, with easy grades, and, for the most part, requiring comparatively inexpensive preparation for the superstructure. The mountain section, with a summit altitude of not exceeding 750 feet, presents no unusual or serious obstacles, and can also be prepared without very extraordinary cost.

Harbors, safe, commodious and easy of access by the largest class of vessels, will be constructed at the mouth of the Goatzacoalcos by deepening the present channel over the bar for a distance of 600 feet, and at the Lagoon by dredging an entrance channel from the Pacific across the intervening sand bars a distance of two miles; by an alternative arrangement, which would somewhat increase the length of the road, this dredging may be materially reduced. At each terminus will be constructed desirable facilities for receiving and discharging cargoes direct to and from the cars, to and from the ships alongside of wharves, whereby an immense business which is now forced around Cape Horn will be drawn to the route. The tolls provided by the grant to be collected for the use of these harbors will rapidly repay their entire cost, and at an early day their entire amount will become net revenue to the road.

The Atlantic terminus will be:

665 miles south from Galveston.
725 miles west-southwest from Havana.
800 miles southwest from New Orleans.
1,905 miles from New York.
2,076 miles from San Francisco.

The route from New York to San Francisco will be about 1,500 *miles shorter than by the Panama line*, and when the contemplated canal across the peninsula of Florida is constructed, this advantage will be largely increased. The route will materially shorten all lines of communication, and facilitate the transmission of traffic between the principal ports of the Atlantic and Pacific oceans, and consequently will attract to it that portion of the trade of California, Oregon, China, Japan, Australia, New Zealand, Manilla, Batavia and the numerous fertile islands of the Pacific, which under these advantages can afford the expense of the Isthmus transit.

The gross tonnage, inward and outward, to and from those localities in 1878, exceeded 2,500,000 tons, wool, wheat, sugar and tea being the most prominent. Australian wool by this route can be delivered in England in 50 or 55 days, giving an advantage in time of from 50 to 75 days; and California wheat can

be so delivered in 50 days, with a time advantage of from 70 to 90 days, and an avoidance of the damage (estimated at 15 per cent.) of twice crossing the equator. Ordinary drafts against shipments by this route may be provided for by sales and actual delivery before maturity.

As a passenger route, the line will offer the inducements of favorable latitude, salubrious climate, direct transit and shortness of sea voyage, with freedom from extremes of heat or cold, blockades of snow, and the vicissitudes of navigation around Cape Horn.

In addition to the eight lines of steamships which now ply to the Gulf of Mexico, new lines will be established on both the Atlantic and Pacific, to meet the requirements of the new course of trade created by this route.

In estimating the probable revenue of the road, it is regarded that despatch, safety and prompt delivery will control the direction of such of the foregoing traffic as is not forced into other channels from economic considerations, and that it is certainly not extravagant to assume that at least thirty per cent. of the above gross tonnage will be transported over this route.

REVENUE.

30 per cent. of 2,500,000 tons, 750,000, at $5 per ton, railroad tariff		$3,750,000
15,000 through passengers, $10 each		150,000
15,000 tons local freight, $5 per ton		75,000
15,000 local passengers, $4		60,000
Tonnage dues, tolls and all other revenue		350,000
Gross earnings		$4,385,000
Deduct for operating expenses, repairs and depreciations, 50 per cent., although with such high tariff 40 will be ample		2,192,500
		$2,192,500
Deduct for allowance to Mexican Government on 15,000 through passengers, 12 cents each	$1,800	
On 750,000 tons through freight, at 25 cents per ton	187,500	
		189,300
Net income		$2,003,200

COST.

In estimating the cost of the road, harbors and appurtenances, it is to be borne in mind that the route is by no means a *terra incognita*—elaborate surveys, maps and profiles have been made under the auspices of the government, one for railway by Gen. J. G. Barnard, U. S. Engineers, another by Gen. W. H. Sidell, U. S. A., and for a ship canal by Capt. R. W. Shufeldt, U. S. Navy, supplementing a survey by Señor Moro. All authorities agree as to the practicabilty and feasibility of the road, the favorable character of the country, and the permanency of the harbors; furthermore, that all foreign material for construction will be imported free of duty; and that the road will be constructed at its lowest money cost without intervention of "construction com-

panies" or other devices, which not unfrequently divert into irregular channels the money of investors.

ESTIMATE.

For clearing, grading and masonry, 130 miles, at $7,500	$975,000
20 miles mountain section, at $25,000 per mile	500,000
Iron Bridges	200,000
160 miles ties and track laying, at $2,750 per mile, including 10 miles siding	440,000
160 miles, including siding, steel rails, 1,500 tons, at $32 per ton	480,000
550 tons fish plates and spikes, at $50 per ton	27,500
Stations, machine shops, tools and fixtures	300,000
Rolling stock	600,000
Harbors, wharves, &c., Atlantic terminus	250,000
" " Pacific "	750,000
Freight, haulage, &c	50,000
Engineering	300,000
Contingencies, 10 per cent	487,250
	$5,359,750

The above estimate is believed to be considerably in excess of the actual amount necessary to open the road, well supplied with all requisite appurtenances to perform its business.

NEW YORK, December 27, 1879.

EDWARD LEARNED, *President, &c.*

SIR,—In regard to your request that we shall give you our professional opinion as to the "feasibility, cost and advantages of the Tehuantepec Interoceanic Railroad, equipped for a business, say, of 750,000 tons per annum, and also of the practicability of establishing good harbors for vessels of 25 feet draft at each terminus, with the probable expense thereof," we have to say :

That from our examinations of the very complete maps, data and statistics furnished by the several governmental and corporate surveys heretofore made, and from other sources of information to which we have had access, including a personal examination of the line several years ago by one of the undersigned, Mr. Van Brocklin, we are enabled to give with great confidence the opinion that the railroad can be substantially built with steel rails and equipped to the extent necessary for the amount of business named, for from four and a half to five millions of dollars, and that safe and adequate harbors can be established at each terminus, by an expenditure in the improvement of the entrances thereto, to admit vessels of 25 feet draft, for about a million of dollars.

That the work can all be accomplished within less than three years.

In regard to the advantages of the route, though not strictly a professional matter, we hold the opinion that from New York via Pensacola and Tehuantepec, San Francisco can be reached in eleven or twelve days.

That via Galveston and via the Missouri, Kansas & Texas Railroad, East India goods, sugar, teas, &c., can be laid down in St. Louis, and probably in Chicago, more cheaply than by any overland all-rail route.

That freight from the Atlantic ports can be delivered in San Francisco in about fifteen days.

That the vast grain crops of Oregon and California will seek European markets by the Tehuantepec route from either of the several advantages it will present over the route via Cape Horn. As we proceed to-day to Mexico, we hope in a short time to supplement this statement by facts from personal observation, which will more conclusively determine the professional opinions herein given.

Respectfully,

[Signed] WM. J. MCALPINE,
Consulting Engineer.

[Signed] M. VAN BROCKLIN,
Chief Engineer.

Mr. HALL then began his remarks, frequently referring to a map of the district. He said :

This important route commences at the Coatzacoalcos river. We propose ending the line at the lagoon or lake upon the Pacific side. The city of Tehuantepec is situated inland about eight miles from the Pacific coast. The greatest height that we have to surmount is about 760 feet, at Chivela. We have to cut a canal from the Pacific into the lagoon, about $2\frac{1}{2}$ miles. That is cut through a sand-bar, which was formerly part of the sea, but which has been formed from the wash from the Tehuantepec river and from other rivers emptying near there. The lake is about 12 miles wide and about 16 miles in length, having an average depth of from 19 to 21 feet, with about four feet of rise and fall of tide. The cutting will give a harbor with 25 feet of water at high tide. On the Gulf side, I found in the survey that we had about 1,200 feet from the line of the coast, a bar of about 400 feet, where we have now about 15 feet of water. That we have, of course, to cut away, and after dredging through this bar we have about eight miles from the coast line on this river, carrying about 38 feet of water.

The line of the route will take this direction [following Rio Nueva], coming off to the westward, coming down through here [on Farifa plains] and passing down through Chivela. At the pass on this highest point we have mountains on each side rising from 8,000 to 12,000 feet. Chivela pass, itself, is only about 26 miles in width, reckoning from the mountains where we come down to the Pacific plains, where is a very beautiful, level and fertile country.

In speaking of Tehuantepec, I want the Society to understand that I am not here to disparage the canals or anything of that kind

—far from it. I would like to see the canal go through the Isthmus of Tehuantepec. The railway will go a long way to assist this enterprise. I have crossed the Nicaragua route. My impression is, a canal never will be built there. On the Nicaragua route we have to traverse a river, and my impressions are that for some 80 or 90 miles it will be almost impossible to dredge or to keep up banks. On the Tehuantepec line you have got, you will notice, this river running up to the edge of these mountains ; you carry a river there for about 90 miles, and then you have this summit to overcome. Speaking of tunneling and cutting deep cuts, my impression is that you can get a canal through Tehuantepec with nearly the same cost as on the Nicaragua route. I maintain that the point of health is one of the main things in carrying through an enterprise of this kind. Then, again, there is no comparison between the two regions of country. It is also much nearer our own shores. At this point [Coatzacoalcos] we have easy navigation for Galveston, Pensacola, New Orleans, from there on to Havana, and, you may say, nearly home. There is no trouble from earthquakes on the Isthmus of Tehuantepec ; earthquakes have not been known there for many years.

I have been some 25 years connected with the Pacific trade, having resided 24 years in Australia, and established the very first Australian mail service to the United States. I took that up single-handed, and opened the service between Sidney and San Francisco, a distance of 7,260 miles—to-day, I think, the longest mail route in operation. My attention was first drawn to Tehuantepec by noticing the straight line that we had from Australia to Europe. Then, from China, the passing through this isthmus gives us another very favorable position. There are many features worth mentioning. After many years' experience, I found that the trade of the Pacific required a different class of ships from those in use upon the Atlantic. The Pacific trade requires light ships, well ventilated, with large carrying capacity. In the Atlantic we know that very heavy ships are required, with very large tonnage, and great speed and good sea qualities. I have been for many years trying to connect with the Union and Central Pacific railroads for the purpose of getting through freights for passengers, specie and different commodities, and have been unable to do it. From San Francisco to New York alone they would have to traverse about

3,200 miles by rail. Of course, to get freight through that length of road becomes expensive. On the Tehuantepec route, it being only 140 miles in length and on a straight line, we would control the better portion of a very large trade between the United States and the Australias; and not only that, but with the Pacific islands. When the Australian service was first started we called at Kandavan, one of the Fiji group; thence went to Honolulu. The trade, at the beginning, on the round voyage to those different islands, would amount to $6,000 or $7,000 ; and we thought that was very good work. To-day that service is paying $30,000 to $40,000, over that same track, stopping at the three points. My round voyages then used to work in about $30,000 ; to-day they are netting about $80,000. That simply shows, by steam communication touching at these different points, even from San Francisco to the Australias, what the service will be. We took in coal at Sidney to supply our ships from New South Wales to San Francisco and back. That also shows the advantages to-day gained by the compound engine. In former days, to do that service, which was really 15,000 miles, would have taken over 5,000 tons of coal; now about 2,500. The service from Sidney to Panama was undertaken by the Panama Steamship Company, but that service failed on account of the heavy consumption of coal and the great distance that they had to steam with no coaling stations.

Judge Daly : The report states that the distance from New York to San Francisco by way of Tehuantepec, would be about 1,500 miles less than by way of Panama. Is that correct ?

Mr. Hall : It would be about 1,300 miles.

Judge Daly : Will you state what the route would be—the sailing route—the shortest distance ?

Mr. Hall : The distance from New York to Panama would be about the same that it would be from New York to Tehuantepec, or rather to Coatzacoalcos; the difference is really on the Pacific side.

Judge Daly: Allow me to ask another question. What would be the advantages over the Suez canal, for a route to India, by Tehuantepec or any of those routes ?

Mr. Hall : I don't think there would be any. For New York, it would be shorter. In coming from China to New York, it would be shorter by way of Tehuantepec than through the Suez canal, thence down the Mediterranean and across the Atlantic. I should say there would be a difference of 1,800 miles in our favor.

Judge DALY: It would make no difference to Europe?

Mr. HALL: No, I think it would not have any effect.

Judge DALY: Nor any canal through the Isthmus of Darien?

Mr. HALL: Well, there are some points where it would, and others where it would not, on account of winds. On the Pacific side, north of the equator, the strength of the northeast trades would be in latitude 16°; and, similarly, latitude 16° south would be the parallel of the southeast trades. So that, really, in coming from the Pacific islands in that direction, we get a fair wind running for the Gulf of Tehuantepec. Now, in making the Nicaragua route, when we get in about 12° north we are getting so far south again that we are running away from the parallel of trades and getting into the calm belt. When on this coast, it is almost impossible to handle a ship under sail; you have to depend upon steam, on account of calms. Panama, I suppose, would be about 8° north. Then you have to go a good distance southward from that before you get into strong winds.

Judge DALY: There is a belt of calms all along on either side?

Mr. HALL: Yes. That is the difficulty you have here, unless you work by steam. I think that a canal cut across by the Nicaragua or Panama route would only be used by steam—that it would be almost useless for sailing vessels. You could not come out in the Pacific 1,200 or 1,400 miles to seaward to pick up a ship. No doubt, when she came on the coast line, there would be steam tugs to carry her through. Most of the trade coming into the lagoon would be from the northward—from China and other northern countries landing their cargoes there, and then passing over instead of coming on the long route around Cape Horn.

When I took up the Australian service, my object was the running of the mails from Australia to Europe. We had a large subsidy for the purpose. We are performing that service now in 42 days, touching at Honolulu, San Francisco and to Liverpool. I am under the strong belief that that service can be performed after the completion of the Tehuantepec route in 32 days. It is a long distance but with the experience that I have had in the Pacific, and with the known speed of ships, I am confident that this service can be performed in the time named. Of course these canals when completed will have some advantages; there is a large trade to be developed

in the Pacific islands. We are now at work on the Tehuantepec road, having a staff of engineers, and I suppose between 200 and 300 men at the mouth of the Coatzacoalcas river. We are now working at that point. Mr. McAlpine and Mr. Van Brocklin sailed on Friday ; they are on their way to the isthmus. The purpose of their visit is to make themselves thoroughly familiar with the Tehuantepec route ; and if Mr. McAlpine's health permits, when he reaches Mexico I rather think he will visit the Pacific coast ; and I hope that when he comes back he will be able to give you information that I have not.

In response to several inquiries, Mr. Hall said that on the Tehuantepec route a tunnel of about 12 miles would be required, with about 22 locks, through an easy country, with principally limestone formation ; that the tunnel would come out about 60 feet above the lagoon, making a fall to that extent necessary before entering the lagoon ; that the water supply would begin with a source that emptied into the upper end of the Coatzacoalcos river. In relation to the cost of the canal, Mr. Hall said that Mr. Garay, who was here some time ago, appointed to represent the Mexican government at the Paris Congress, estimated the expense at about $60,000,000. But Mr. Hall thought that was an estimate wide of the mark where a tunnel of such length and magnitude was to be cut. But where Mr. Garay's estimate was for 80 locks to the summit, and then down, this tunnel would require only 22 locks. After coming through upon the Pacific side, the tunnel would be 56 or 60 feet above the sea; and then it would come down on to what is called the Pacific plain. Mr. Hall was not able to say how high the body of the canal would be above the ocean. As a harbor, the mouth of the river on the Atlantic side is about 1,500 feet wide. A bar is there which must be removed; but from surveys it would appear that the sand there has not varied or shifted for the last 30 years. The tunnel would not be an open cut, but a regular tunnel, principally through limestone. There would be about 20 locks in all—10 on the Pacific side and 10 on the Atlantic. Mr. Hall said, that from advices by the last mail from Mexico, it was his information that the Mexican government had sent engineers to make a thorough survey, and regular reports for the canal, and he believed a communication on behalf of the Mexican government was to be presented to our government, asking the United States to withhold support until this survey could be made.

In reply to a question by Judge Daly, Mr. Hall said that he thought it would be found very difficult to compete with the Suez canal for the Indian trade. The Suez canal has a peculiar advantage in having no locks. Vessels generally anchor over night at the mouth of the canal; at daylight they enter the canal, and about sunset of the next day they are through; they always use steam power. Upon the Tehuantepec route, with the number of locks that would be necessary and the stoppages, Mr. Hall thought that it would take three days, or in that neighborhood, to pass a vessel 360 or 370 feet in length; but he thought for trade from Calcutta and China, there would be a gain for American ports of from six to eight days, and therefore great advantage would accrue to the United States; but for Europe he did not think it would be much used, except it might be for the west coast trade.

Major Sherbourne inquired whether, for the numerous islands in the South Pacific, a canal by the American isthmus would not be much nearer.

Mr. Hall thought that for the Australian, New Zealand, Tahite, the Feegee group and the Sandwich islands trade, it would be nearer for Europe to avail itself of the American isthmus for steamers, but sailing vessels would not attempt it; they would go round Cape Horn in preference.

An inquiry was made as to whether steam was not rapidly superseding sailing vessels.

Mr. Hall replied, not in all kinds of trade; many classes of freight could be carried cheaper by sail; although it was true that the use of steam was on the increase. But there was much time lost in collecting freights among the Pacific islands, and the expense of working a sailing ship would not be one-half that of handling a steamer of the same tonnage.

Major Shelbourne inquired whether, in laying out a line between Australia and Europe directly through Tehuantepec, Mr. Hall had considered whether it was equivalent to great circle sailing.

Mr. Hall replied, Yes; that the plan which he exhibited was on Mercator's projection; that it had been furnished by the British Admiralty for the Australian service some years ago.

Mr. Chanute inquired which would be the short line from Great Britain to the eastern ports of China.

Mr. Hall said that he would go through the Suez canal—that it would be considerably shorter in positive sailing distance.

In response to an interrogatory, Mr. Hall said that he thought very few sailing vessels go through the Suez canal; that there were some transport-ships that went through by the aid of tugs; that the strong winds are not met until some distance below Aden.

In response to a suggestion, Mr. Hall said, that if a canal were cut across Florida a great deal would be saved in sailing distance and in insurance—a saving of at least 200 miles between Tehuantepec and New York; that it was proposed as a quick line to run from the Coatzacoalcos river to Pensacola, and then take an air line from there to New York.

Judge DALY: As I understand, you navigate the Coatzacoalcos river to a certain extent, and then your line begins.

Mr. HALL: No; we have abandoned that. It was first recommended to run up 22 miles from the mouth. That was General Barnard's plan, but it has been abandoned. We start directly from the mouth of the Coatzacoalcos river and have a railroad the whole way. The entire distance would be 150 miles from the mouth of the Coatzacoalcos river to where we end at the lagoon.

It was inquired whether there were any mountain torrents to interfere seriously with the road.

Mr. HALL: We keep on the dividing range. When we start from the mouth of the Coatzacoalcos river we run on nearly a level for 14 miles. Then we strike the dividing range, and we keep on this divide until we get to Chivela. We avoid all mountain torrents. The first survey that was made followed the level of the Coatzacoalcos river, but we find that a better plan is to keep away from the currents, although the distance is a little further. In a direct line it would be about 130 miles, so that we lose about 10 to 20 miles. For the first 30 miles we will have to send our ties from Florida; but for the rest of the distance we can get very good timber for the purpose. The principal timber on the isthmus is mahogany. The ties we get from Florida are hewn and of pitch pine. The Vera Cruz and Mexican Railway have been getting lately many of their ties from Cedar Keys and Pensacola.

Mr. Hall remarked, in conclusion, that this railway was quite interesting; that it runs a distance of 14 miles on a grade of 212.

Judge Daly then introduced Mr. John E. Body.

Mr. BODY prefaced his remarks upon the main subject of the evening by narrating an interview a few years ago between himself

and Lord Kimberley, Secretary for the Colonial Department at London, formerly known as Mr. Wodehouse, Under Secretary of State. Speaking of the opposition of Lord Palmerston to the building of the Suez canal, the Secretary remarked that the opposition was confined to Lord Palmerston, who, in this respect, was not supported by the rest of the cabinet; that it was a part of the method of the British system to have as few fixed points of necessary agreement among the members of the government as possible, and while all were generally agreed upon general subjects, there were many matters upon which each member held and expressed ideas peculiarly his own. Lord Kimberley was exceedingly sanguine about the Nicaragua canal across the American isthmus, and thought it was bound to be built. Being asked by Mr. Body if he knew of any reason, political, military, or otherwise, that would make the building of a canal by way of Nicaragua objectionable to the British government, he replied that he knew of none whatever. He said that Great Britain considered herself at the head of the industry of the world, and that whatever shortens time or distance is in favor of the industrious nations. Being informed that the government of the United States was about to make surveys of the different routes which had been projected for the forming of a line of communication between the Atlantic and Pacific oceans, he suggested that, in the matter of the sending of a surveyor by the British government to accompany such expeditions, Mr. Body should see Earl Granville. Earl Granville thought, as the survey would be so purely American, while wishing it every success, it would be more appropriate for Mr. John Fowler, an eminent engineer of London, to send one of his surveyors rather than that the government should send a directly accredited representative. That it made no difference to the English government whether the canal was built by Englishmen, Frenchmen, Germans or Americans, so long as it was built, it being purely for commercial purposes, and let him do the work who can do it best and cheapest. Earl Granville said that the opposition of Lord Palmerston to the Suez canal caused a great deal of French money to be invested in it; it was thought by the French that the canal would be a serious blow to English commerce; that the trade of England with the East would be cut in two, and that France would be a great gainer. Earl Granville corroborated Lord Kimberley's statement that the attitude of Lord Palmerston with reference to the Suez canal was wholly individual, and confined to himself.

Mr. Body stated that he was President of the Central American Transit Company, who were the successors of the Atlantic and Pacific Ship Canal Company, the original grantees by the government of Nicaragua for a canal, and that eminent counsel had advised that the successors of the Atlantic and Pacific Ship Canal Company had the right as such successors to build the canal. Mr. Body also said that he had been connected with the Nicaragua route since 1850, and said that the greater part of his business life had been passed in watching the isthmus, and trying to forward the views of the company that he represented.

Mr. Body then spoke upon the topic of the evening as follows:

The range of mountains extending from 95° W. 17′ N. to 76° W. 4′ N., a distance of about 1,700 miles, including the Tehuantepec and Darien isthmus, forms one single chain in its entire length, and of such altitude that the navigator, having their summits constantly in view at a distance of 100 miles, can run his course by their direction. They screen the Pacific ocean from northers, except at Tehuantepec, where the depression of the chain in a north and south direction admits those furious winds to a limited action on that otherwise still sea.

The adjacent republic of Guatemala presents no such depression in her mountains. Nor do San Salvador or Honduras invite the passage of northers. These states, as well as the republic of Costa Rica, may be called mountainous regions having in their altitudes vast plains, fertile in all that the heart of man can desire, with a very salubrious climate; this is especially the case in Nicaragua, which is celebrated for its productions of coffee, sugar, indigo, cocoa (the finest in the world), cattle, and all kinds of fruits; hides, deer-skins, india-rubber, and an abundance of medicinal roots and plants; gold and silver mines, many of them of great antiquity and considerable richness.

Nicaragua is an old settled country, with a high civilization in its capital cities, and a widespread common school education all over the land. It is rare to find a man who cannot read and write, even in the lowest grade of laborers. The upper classes are just as well educated as we are, and fall in no degree short of our standard in the refinements of society; they are eminently a polite and hospitable people.

Nicaragua, like all the tropical countries of Central America, is

short of population, and cannot be relied on to furnish the labor to build the canal, except very partially. We must look to China and the West Indies for working hands; but Nicaragua offers abundant and very cheap meat, fish, corn and fruits along the entire line of the proposed canal.

Moreover, there is no danger of having to fight hostile Indians in prosecuting the work; none exist upon the soil of the republic.

The geographical arrangement of Nicaragua differs from that of all the states in the range from Tehuantepec to Darien. *Nicaragua has two ranges of mountains running nearly parallel to each other:* the eastern range, which joins the mountains of Honduras, and is separated from the mountains of Costa Rica by the valley of the San Juan river; the western range, which begins with the mountain El Viego, 6,500 feet high, and runs a southeast course along and near the Pacific coast until it joins the mountain range in Costa Rica, which continues its southeast direction until it is merged into the great South American Andes.

In the departments of Metagalpa and Chontales, the eastern range of mountains discharge about one-half their water into the basins of Lake Managua and Lake Nicaragua. These two lakes are connected, and the outflow from Managua into Nicaragua lake is very considerable at high-water season, but it has never been gauged; at low water they do not connect.

In Lake Nicaragua, near its southwestern extremity, immediately opposite the entrance to the projected canal, which it protects from easterly or trade winds which prevail, is the island of Omotepec, about eleven miles long, having a remarkable mountain upon it, 6,500 feet high, almost a perfect cone in form. This remarkable mountain towers above everything surrounding, and is visible to the eye, and forms the true bearing for approaching the shore to ships, more than 100 miles out at sea.

In the Pacific or western range of mountains, in the immediate neighborhood of this giant sentinel, is found the lowest elevation in the mountain range, which separates the waters which flow into the Atlantic from those which fall into the Pacific, from the Arctic ocean to Cape Horn.

These facts are of such paramount importance that their discovery could not fail to interest the scientific world and to prompt men of enterprise to endeavor to acquire a geographical position which,

in my humble judgment, has not its equal on the face of the globe.

Here let me fulfill a duty, which has been inexcusably neglected of late, to the memory of a truly great man, who was formerly state engineer of the state of New York—the late Orville W. Childs. Of his report on the interoceanic canal via Nicaragua, which I had the honor to submit to Mr. John Fowler of London, that eminent engineer said to me: "It fulfills all the requirements of modern engineering. I have read it with much pleasure on my journey from London to Scotland and back, and you may say that I endorse all that Mr. Childs has said in his report."

The various expeditions sent out by our government to survey the different routes which were proposed for the canal were all furnished with the report and maps of Mr. Childs.

It would be presumptuous in me to say that the opinions of Mr. Childs, formed in 1850 and 1851, must rule now. The recent surveys have been in very able hands, and have led to the discovery of economic facts of greater or less importance, more especially as the canal now is to have a depth of 28 feet instead of 17 feet, as laid out by Childs in 1850 and 1851; yet the main features of the canal route remain the same.

It was this very canal across Nicaragua, of which we hold the franchise from that republic, which called forth the Treaty of Protection, which, speaking in the name of modern civilization, says that they who do the work shall be protected in its possession—their capital shall be secure, and they shall enjoy the benefit of the enterprise.

In contemplation of the fact that Great Britain and the United States entered into a convention on the subject of this canal, I may be excused from noticing the unworthy insinuation that the work is a sentimental project.

Acting under very liberal instructions from Mr. Cornelius Vanderbilt and his associates, to determine the best line for an interoceanic canal, a survey was made and embodied in a report of the cost of constructing the interoceanic ship canal from the harbor of San Juan del Norte or Greytown on the Atlantic, to the harbor of Brito, on the Pacific, in the republic of Nicaragua, Central America, made to and for the American Atlantic and Pacific Ship Canal Company, in the years 1850 and 1851, by Orville W. Childs, chief engineer. The report embraced also a topographical description of

the country, a thorough reconnoissance for a line from Salinas bay, on the Pacific, to the Rio Sapoa, an affluent of Lake Nicaragua; also, a line to the north of Rivas, which, after investigation, was deemed impracticable and was abandoned in favor of a line to the south of Rivas city, in the department of that name, from Lake Nicaragua to Brito harbor, using the Rio Lajas, which falls into Lake Nicaragua, and also the Rio Grande, which falls into the Pacific at Brito. The summit level between these rivers is only 46 feet above high water in Lake Nicaragua, and has a width of only 1½ miles; it is approached on each side up a generally broad and uniform plane.

The level of Nicaragua lake at high water is 103 feet above high water on the Pacific, and 111½ feet above the lowest tide level. The fall to the Atlantic is 107½ feet to the level of high water, and 108¾ to the level of low water, in San Juan del Norte, or Greytown harbor. The distance over which this fall is distributed is 119 miles of good navigable water, when the river is only half full. The pre-eminent advantage of the Nicaragua route for an interoceanic canal is the inexhaustible supply of water at the summit level. The great lake of Nicaragua has an average length of about 110 miles by an average breadth of about 25 miles, and receives the rainfall of more than 200 miles by 50. It is the great reservoir of water of Central America, which unquestionable fact marks it as the natural line for an interoceanic canal.

Colonel Childs estimates the quantity of water to supply canal navigation from the summit level, including evaporation, infiltration and leakage to locks, at a 105,130 cubic feet per minute, and the same eminent authority shows, by the test of its gauges, that the average outflow of the lake is 899,000 cubic feet per minute.

These tests were made from the 23d of December, 1850, to the 27th of April, 1851. They began when the lake was 3½ feet above low level, or about the middle stage, and they give the result that in that period of 125 days the supply from the lake was 143,022,600,000 cubic feet in excess of the requirements for the canal and its navigation, to pass three ships through its locks every hour. The great rise of water caused by the autumn rains had about half run off when the test of Colonel Childs was made. A rise of water in the lake of five feet only is a low supply. It is frequently six feet and upwards, and upon the area of this inland sea the increased volume in excess

of low-water stage may be roundly stated at 400,000,000,000 cubic feet, without estimating the immense quantity which has to run out of the lake during the time when the rise of water is going on.

The rainfall, which is among the heaviest in the known world, having been gauged repeatedly, is found to give 98 inches for a year, or a fall of solid water eight feet deep, over an area four times the surface extent of Lake Nicaragua itself.

In consequence of the immense area of this lake, the water rarely rises over one or two inches a day, and its outflow by the San Juan river is regulated accordingly. In an experience of 25 years, there has not been a time when, on account of the rapidity of the current, the San Juan river, up or down stream, has been impassable, or even difficult, to steamers capable of making six miles an hour. It is during the season of the heaviest rains and high water on the lake and river that our steamers for the lake service have been sent down to Greytown, thence up the river to stations on the lake; this could not be done on any other river of Central America.

I believe myself justified in saying that no conditions exist on this continent so favorable to the construction of an interoceanic canal as are offered by Nicaragua, and this opinion I hold in common with very many men distinguished in science, whose views are on public record. The report of Colonel Childs fixed attention to this project and culminated in forming an American company to construct the canal. Of the report itself, I desire to say that it remains unchallenged after nearly twenty years of public exposition, and has received the approval of the engineer specially appointed by the British government to examine it; as also of our own board of topographical engineers at Washington, to whom it was referred by the President of the United States, in 1852. They reported thereon through Col. J. J. Abert and Lieutenant-Colonel W. Trumbull, of that bureau, who said: "We think the plan as proposed by Mr. Childs practicable, there being an abundant supply of water in the summit lake alone, apart from other supplies below it; that no other route is so adequately supplied with water, and that the work could be done at the amount stated upon his exposition of quantities and labor."

The large interests held by ourselves in Nicaragua have rendered all projects for explorations to discover new routes of communication between the oceans of great importance, and they have re-

ceived earnest consideration. But I desire to state, as the result of my steady attention to this subject for upwards of twenty years, that, so far as my knowledge extends, no interoceanic pass has been discovered which was not known to the old Spaniards and their cattle hunters, and was used by the Indian inhabitants of the continent in times preceding them—and they were not a barbarous people (as the magnificent ruins of their cities testify to this day), but a people who have left very important evidences of active communications with Central America, both from the north and the south. The conclusion is not unreasonable that no new route will be discovered.

The naval authorities at Washington, some years ago, expressed the opinion that the interoceanic canal, in width, depth and supply of water, in good anchorage and secure harbors at both ends, and in absolute freedom from obstruction by lifting locks or otherwise, must possess as nearly as possible the character of a strait, and the recent expedition to Darien sought in vain to discover these conditions. It is generally assumed now that they do not exist; and it is proposed to supply the deficiency of nature, and to pierce the mountain range by a tunnel on the ocean-level to be used by sea-going ships, the feasibility of which can only be decided when the fact shall be accomplished.

It is not certain that the Cordilleras are solid at their base; they may be seamed with enormous caverns, caused by the upheaval of their gigantic mass. All reports so far agree that the structure of this portion of the great chain of the Andes is substantially a trap-rock formation, a submarine overflow from the bowels of the earth at different periods, which carried up with it boulders of granite mixed in its mass, and in its latest elevation above the ocean raised also much drift and alluvium. This trap-rock is too loose and separate in its parts to be useful for construction. Whether such a tunnel, if made, would support itself, is more than we can decide; who would, or could, guarantee its permanent safety?

The sober sense of mankind will avoid such desperate risks, which have not the recommendation of cheapness to offer as a compensation, and we must look to the system of above-ground water communications alone as they exist in Nicaragua.

The engineers who planned the different tunnels in the Darien and Panama canal schemes were driven to such contrivances by

the contemplation of the practical impossibility of making a deep cut from ocean to ocean, which would have the desired character of a strait for ships to pass through on the ocean level.

We may except the scheme of M. de Lesseps, which has so recently been brought forward, for a canal on the ocean level. It has no tunnel to pass through, but a bottomless swamp, 12 miles long; also it requires a dam about a mile long and 150 feet high to hold up the waters of the Chagres river; likewise a tide lock at Panama, where the tide rises and falls 20 feet. His projected canal will only pass one ship at a time, and its cost is estimated by American experts at \$400,000,000. On commercial principles such a scheme can hardly be entertained, but there may be political reasons of which we know nothing.

Theoretically, a tunnel of any length or size may be assumed as possible, but it by no means follows that because a tunnel through the granite of Mount Cenis, sufficiently large to pass a railroad carriage, is practicable, that a tunnel 160 feet high by 100 feet wide through the loose trap-rock mountains of Central America, sufficient for the largest ships to pass through, is practicable.

We are, for reasons before given, as well as for others concerning ventilation and navigation, compelled to reject all canal schemes having long tunnels, whether they be on the level of the ocean, like the San Blas, or high up in the air, with a more than doubtful water supply all the year round.

The line across Nicaragua, as surveyed and laid down by Childs, is free from the objection of tunnels, great or small, *and has at its summit a level of navigable water (from Castillo on the San Juan river to the first lock descending to the Pacific) of* 103 *miles without an impediment of any kind. This is a sea of fresh water at the summit,* 12 *feet lower than the reservoir in Central Park, City of New York, inexhaustible in quantity, and the rim which confines it on the Pacific side is only* 46 *feet high.*

In regard to the comparative cost of the construction of an interoceanic canal, the distance from ocean to ocean is reduced nearly one-half by the use of the San Juan river for $90\frac{80}{100}$ miles, and costs only \$12,528 a mile, according to the computation of Childs, to make it complete for service.

The artificial canal of Childs, leading from the San Juan river into Greytown harbor, $28\frac{1}{4}$ miles, being an earthwork altogether,

costs \$164,752 a mile, whereas the section work on the Pacific, 17¾ miles long, being mostly stone excavation, costs \$439,372 a mile. The locks on the San Juan river cost, on an average, \$248,246 each, and the dams \$224,574 ; on the earth-canal the locks cost \$245,265 each. On the Pacific side the locks cost rather less, averaging \$224,572 each.

Fortunately, the amount of cutting at the summit, between the lake of Nicaragua and the Pacific ocean, is principally confined to a section five and a half miles long, with a summit elevation of 46 feet above the lake, about one and a half miles long; but this piece costs at the rate of a million dollars a mile.

The outflow of the San Juan river from the lake of Nicaragua, has worn a channel for our use which would have cost incalculable millions to remove by any process of art known to man. These estimates which have been made by Mr. Childs were based upon formal survey, and are accompanied by ascertained quantities of above-water excavations, and under-water excavations in the various earth, rock, gravel, clay and sand encountered between the two oceans, and the price of such excavations varies from \$3 per cubic yard for submarine rock, to as low as \$1.40 for rock work very favorably situated; but the principal rock excavations above ground are calculated at \$1.60 per cubic yard, earth excavations generally at 35 cents per cubic yard, gravel and clay at \$1.50 per cubic yard, and sand at 25 cents per cubic yard in gold, and the depth of the canal and its locks was for vessels drawing 17 feet. The entire work was estimated to cost \$31,500,000. The same work well located in New York State would cost only \$13,500,000.

The larger dimensions of the canal proposed by Mr. Menocal will probably bring up the cost of a 28-feet-deep canal to \$55,000,000 as against \$31,500,000 for the 17-feet-deep canal of Childs. I have great faith in the ability and good judgment of Mr. Menocal, which he has shown by his plan of carrying the canal from Greytown to a point above where the San Carlos river enters the Rio San Juan.

The harbor of Greytown, when I first knew it in 1850, was large, deep, and well sheltered, and was a favorite rendezvous for ships of war ; and the most ancient maps have this harbor laid down. We hear a great deal said about the moving coast sands, but the loss of the harbor was not brought about primarily from that cause. It was the result of a freshet of unusual force, which carried away a small

island in the San Juan river, a little above the divergence of what is called the Colorado branch of the Rio San Juan, which allowed a large increase of water to pass down the Colorado branch, impoverishing just so much the current of water which heretofore formed the lower San Juan branch, and had sufficed to keep the entrance to Greytown harbor open and with sufficient water at the bar to admit the entrance of the largest ships.

With a powerful river like the San Juan in its rear, if the same means were adapted to deepen the harbor and its entrance which have been put in practice upon the mouths of the Danube and the Mississippi rivers, there would appear to be no reasonable doubt that Greytown harbor may again be made available for the purposes of commerce and especially for the entrance of the canal. The San Juan, the Danube and Mississippi discharge their waters into almost tideless seas, and the depth of water on the bars of the Danube and Mississippi has been more than doubled by the simple process of embankments and jetties. It is a question of cost; but if the engineers of the Nicaragua canal should decide, after fully weighing its probable results, that such method should not be undertaken, and that an artificial entrance to the canal by means of piers or jetties outside of Greytown harbor is the best for so vast a work as the canal, it seems to me a very weak objection to the plan that the piers may possibly require to be lengthened at certain times when the supposed drift of the sands along the coast shall reach the mouth of the pier entrance and threaten to obstruct it. Allowing for the sheer possibility of this action of the sands, it must be reckoned as one of the standing expenses of the canal to provide a fund to lengthen the piers.

The Suez canal is most likely the reopening of a navigation which in very ancient times united the Red Sea and the Mediterranean. Africa was then an island, and Egypt did not exist. The Nile having its sources under the equator, created Egypt, and the mud of the Nile, passing out to sea, was carried easterly by the Mediterranean current, and thus gradually filled up the waters which separated Africa from Asia, and formed the Isthmus of Suez.

The same process is going on to-day, and the piers of the Suez canal will have to be lengthened from time to time, because the Nile mud-deposits always did and always will be formed about the entrance of that canal.

The great trade of our isthmus canal will probably be the coasting trade of the United States, and the direct trade of California and Oregon with Europe.

Who can measure the future of the west coast of this continent, or assign limits to the intercourse of mankind, the moving to and fro of nations, and the living activities which Asia, awakened from her slumber of thousands of years, must infallibly call into life? Where is the limit of the probable? Ask the experience of the past, and it will tell you that the facts of our own day far exceed the stretch of the most sanguine expectations of our youth—and so to the future will the doings of our times appear insignificant compared with the facts of our next generation, and in nothing so clearly and demonstrably as in the *movement* of mankind, the increased wants of civilization and the means of supplying them, of which the interoceanic canal will be the most illustrious fact.

Why subject this trade for all time to the unnecessary burden of an additional distance of seven hundred miles by any of the routes which end in the Bay of Panama? They are all too far south for the interests of the United States.

If the Nicaraguan route should cost twice as much as any of the Panama routes, it would be better to build the canal by the way of Nicaragua, even at that cost. Instead of this, the estimated cost of the Nicaragua canal is scarcely half the cost of any of the Panama Bay routes, and not one sixth of the costs of M. de Lesseps' projected canal.

In regard to the proper location for the interoceanic ship canal, have we any room to doubt? The white clouds which cling like pennants to the lofty top of Mount Ometepec, proclaim to the nations of the world, "This is the gate of the two oceans."

Upon the conclusion of Mr. Body's remarks,

Judge Daly said: All the routes have been examined during the four sittings of the Society, with the exception of the Panama route. Mr. Appleton expected to be present at the last meeting, but he was unexpectedly called ,to Boston and has not returned. I received a letter from him yesterday, in which he expressed his strong desire that there should be a full exposition of the merits of the Panama route, and he suggested that, as he was unable to be present, Commodore Mead, who has just returned from Panama, might

come here to-night and give us an account of the Panama route. I sent a messenger to Commodore Mead with Mr. Appleton's letter, but the Commodore stated that, as he was acting for the government, he did not feel at liberty, at present, to make any statement that might be published. We therefore need an exposition of the Panama route to enable us to complete the subject.

I do not know that we shall sit again. The investigation has been very exhaustive; and as everything that has been said will be recorded and will be printed, I think we shall have a very full presentation of the views entertained of all routes, except that by way of Panama. On that route we can say that we have a great many objections recorded against it from gentlemen who favor other routes. But it is desirable that the Panama route should have some advocate here, one fully acquainted with it, prepared to answer the objections made against it, if they are answerable. I shall take occasion before the proceedings are published to communicate with some gentlemen who favor that route, in order to obtain such an account of it as they may be willing to furnish.

I received a letter from M. de Lesseps before his departure from Europe, stating his intention of coming to this country and visiting this city, which I suppose he will do after he has finished the inspection of the Panama route. It was intimated at the first meeting, at Chickering Hall, that he would be invited to meet this Society. We propose to give him a public reception upon his arrival here, either at our house or at Chickering Hall, where a large number of members can assemble to receive him, and hear from him such an exposition as he may desire to give. As a distinguished citizen of the world, who has conferred great benefit upon mankind by the opening of the Suez canal, who has accomplished one of the extraordinary enterprises of this age, we propose to have our reception personal, leaving him to address the Society if he chooses to do so upon the subject of the Panama route. I have corresponded with him during the progress of the building of the Suez canal, and I can say that certainly as many objections were raised to that route, and as many statements made of the impossibility of its accomplishment, as have been made to any of the routes that have been discussed during these sittings. The Suez canal was pronounced impracticable from almost all quarters, and various reasons were suggested why it would prove so; most of which proved to

be unfounded, and some of which were very serious, but were ultimately overcome; and Monsieur de Lesseps enjoys very great triumph in the success of the enterprise which he undertook almost single-handed, and for the wonderful way in which he enlisted the pecuniary aid necessary to the performance of the work.

I but express the feeling of the Society when I thank the gentlemen who have discussed these questions. With the exception of Mr. Body, who is an old member of the Society, I believe they have not been connected with it; they have been engineers, who have discussed it from a practical point of view. We are very much indebted to them, and I think the commercial world will consider itself indebted to them for they have given us practical views of men entitled to be heard.

We have Mr. Kelley with us to-night, and I asked him whether he had anything that he would like to say upon the subject of the San Blas route. Mr. Kelley, I believe, has spent over $100,000 in getting up surveys of the isthmus, a matter of private enterprise, and he is entitled to the thanks of the commercial world and especially of this country.

Judge Daly then introduced Mr. Kelley, who spoke substantially as follows:

Mr. KELLEY said: My plans have been discussed so much that it seems to me hardly worth while to say anything. My friend Major Shelbourne handled the subject much better than I could, and I could only go over the same ground.

My effort has been to find a canal practicable, without locks, and I believe that is the only manner in which it will be built. In my judgment the San Blas is the best route of all, because it is the shortest route. Short lines are what the commercial world want —quick lines. Ships want to go through on an even keel; they do not want delay; they want harbors already made; they want harbors that are natural and that will remain open naturally, with no necessity for dredging to keep them open. Ship captains and shipping merchants in this country and in Europe are all agreed in this respect. On the San Blas route the total distance through is 30 miles, 10 of which is the river Bayano, almost suitable for navigation, and of the remaining 20 miles, seven is a tunnel. That is the only spot that I can see anywhere on the isthmus that a sea-level canal can be built. It is only a

question of time when the commerce of the world will demand a deep, wide cut through the shortest part of the isthmus. A canal by way of Tehuantepec or Nicaragua will not satisfy commerce. Large ships of from 4,000 to 7,000 tons burden will not cross that isthmus through locks required to be 400, 500 or 600 feet long and constantly liable to get out of order. The question is not so much one of cost as of convenience and facility. What are $30,000,000 or $50,000,000 more or less in a work of this kind, which is to last forever, and accommodate the ever-expanding needs of trade. The world has the money; there is enough to build this canal if it should cost $200,000,000. The state of New York has spent more than that amount in public improvements. What are $150,000,000 for the world? There is a great deal in having a canal that will be economical to maintain when finished. A canal must have something besides dirt to line its embankments. No dirt embankments will stand in that climate without walling. If the canal is 60 miles long, you must have 120 miles of something besides dirt for embankments. The Atrato river has natural embankments, the growth of ages, but they are like sieves, and hold no water. That is the same with the banks on Nicaragua or at Panama. Wherever a canal is built, there must be stone embankments or something besides dirt which the rains of a night will wash away. Those who have figured estimates have not included this expensive item. All are interested in making their estimates as low as possible. You cannot build a canal through Nicaragua 28 feet deep and 125 feet wide for less than $125,000,000. Of course you can build a small-boat canal there for less money. But we are not talking of that—we are talking of a ship canal large enough to satisfy the commerce of the world for all time. From all the late surveys, the least quantity of material to be removed is on the Napipi, and next to that comes the San Blas route. A tunnel 80 feet wide at the water surface and 140 feet high above the canal bottom to crown of arch is sufficient. You can have it a little higher, or a little lower, if you please; that is merely a matter of convenience. Eighty feet in the tunnel is wide enough for one vessel. A ship can pass this route in ten hours, towed at the rate of three miles an hour; 100 ships can pass from one ocean to the other in 10 hours and 100 back, making 200 in 24 hours. No other route will furnish such facilities. The heading in the tunnel, of which there are 332,642 cubic yards, is estimated at

$20 a cubic yard ; break-down, containing 10,090,080 cubic yards, at $5 ; open-rock cutting, 15,011,219 cubic yards, at $1.50 to $2.50; earth excavation, 3,995,895 cubic yards, estimated from 50 to 75 cents a cubic yard ; masonry, amounting to 54,446 cubic yards, estimated at $15 a cubic yard; concrete, $7; pumping, 2,500,000; and the total cost of the canal finished from ocean to ocean, including 25 per cent. for contingencies, would be $104,017,780. If the tunnel should require lining, its entire length, which the firm character of the rock does not indicate, then about $30,000,000 additional would have to be added to the above sum. The total quantity of material to be removed on the entire line would be 29,389,828 cubic yards, of which 25,543,939 cubic yards is rock—the safest, best and most reliable material out of which you can construct the canal; the remainder is earth—nearly 4,000,000 of cubic yards. So we have 25,000,000 yards of rock and something over 3,000,000 cubic yards of earth. The harbor of San Blas, on the Atlantic side, is excellent. Of it, Commander Selfridge says that "San Blas has a most magnificent bay, with deep passage and fine anchorage, perfectly protected from the north winds. In the northwest corner is an inner harbor, formed by a circle of islands, with a passage leading into it a mile wide, capable of holding easily all the shipping of an immense traffic." There is not a blow to be struck in that harbor, not a single dollar to be spent on it, except to put up light-houses. These are the kinds of harbors we want for a ship canal—natural harbors, which ships can reach at all times—harbors that are not constantly filling up, and that, in order to keep open, it will be necessary to dredge as long as the world exists.

A member of the Society said that the speaker had referred to a canal without locks, but it was understood that the tide in the Bay of San Blas, on the Atlantic side, had less than two feet of rise while on the Pacific side the rise was 22 feet. He inquired how Mr. Kelley proposed to overcome that without locks.

Mr. Kelley : Latterly the discussions have been in the papers and before the Paris Congress of a canal "without locks." This is not a proper term. The proper term is a "sea-level" canal. But no lift lock will be required. The tide rises on the Atlantic side from 18 to 24 inches ; it rises in the Bay of Panama from 12 to 18

feet. To overcome that difficulty we have to place a tidal lock on that side of the isthmus.

Now, I wish to call your attention to one point: the only practicable route that exists anywhere on the isthmus, without a lock-gate, a dam, or any obstruction is the Atrato and Truando route.

[Mr. Kelley here pointed out the lines of the Panama railroad, the San Blas route, the old Darien route, the Atrato and Truando route, the Napipi route, and the San Juan route.]

Mr. KELLEY continued: Baron von Humboldt states in his writings, that as early as 1788, a Spanish priest constructed a little canoe canal and at that early period bungos ascended the Pacific coast to the San Juan, ascended that river to San Pablo, and there their cargoes were discharged into small canoes, taken through that canal, then put into bungos, and a descent was made down the Atrato to the Atlantic ocean. He states that there was a water passage. We surveyed that route and such a passage never existed. Yet it is a remarkable statement, for it is the lowest summit that has ever been found. That statement made by Humboldt in his work on Central America is untrue; no canal ever did exist or could exist, for the reason that the headwaters of the Atrato are 102 feet above the San Juan, and the Atrato at that point has only canoe navigation, the San Juan having about 10 feet of water. If that had been the highest point, it might have been available but there is no water to feed it. My surveying parties were all through this valley during 1852, 1853 and 1854. I had it thoroughly explored, and the result is what I now state.

Judge DALY: What is your opinion in respect to the possibility of finding any lower summit level through the isthmus?

Mr. KELLEY: It is not possible at all.

Judge DALY: In other words, you think, if it had existed, the Indians would have found it out?

Mr. KELLEY: If there had been a low summit, in all probability the Indians would have found it out. What I mean is, no such thing as a dead level exists anywhere on the isthmus. The summit of the Panama railroad is the lowest summit, and that is 290 feet above the level of the sea. The San Blas summit is 1,500 feet above the level of the sea. It is not at all likely that any lower summit than 150 feet will be found. Entering the Atrato at the Gulf of Darien, we ascend it for a distance of 67 miles, and on

reaching its junction with the Truando we are 20 feet above either ocean—a natural summit. From there we turn to the right, deepen and widen that stream by dredging, and make a through cut into the Pacific ocean at Kelley's inlet, the result of which would be that this great river would have two mouths, one discharging into the Pacific and the other into the Atlantic. At the point of separation, which would be the summit level of the canal, it is 20 feet above the mean tide of either ocean. The supply of water would all be drawn from the Atrato at that point. This is a grand river, 220 miles long. Two *Great Easterns* can float up the Atrato river at this point. Once the canal was made, the Pacific would have a flow out and in of 12 feet, and the Atlantic would have a flow of two feet. But never would there be an overflow of the 20-feet summit. That is why it is practicable without a lock. The waters of the two oceans never would unite on that line. That summit is just right to accomplish these results. But the objection to that route is that it is 131 miles long—an excess in distance of over 100 miles over the San Blas route. Again, the bars at the mouth of the Atrato must be improved by a system of dredging or jetties, or some other plan to clear away obstructions. In the third place, there is a harbor to be created on the Pacific side. The probabilities are that the immense quantity of silt passing out of this river would create another sandbar which would give considerable trouble. By way of San Blas the harbors are natural; it is only 30 miles long, and we are out of the reach of the enormous flood of waters that would be met on the Atrato.

Being interrogated as to the climate, Mr. Kelley said it was bad throughout the whole isthmus—the Nicaragua, the Panama, the San Blas and the Atrato regions were all about the same in the matter of climate, but the Pacific side of the isthmus was much the drier, and there was the longest slope of open cutting in the San Blas canal, which was a great advantage.

Capt. Jenkyns C. Battersby then made a few remarks, in which he deprecated the building of a canal or the projection of any route along a water-course, on account of the danger from sudden and excessive freshets, saying that the safety and perpetuity of such a work would be proportionate entirely to the amount of rock through which it might be cut.

Adjourned.

Estimates for a Ship Canal, Railroad, etc., across the Isthmus of Panama.

By Henry Tracy, Civil Engineer.

[From the original deposited in the Society, by Charles M. Tracy.]

The surveys made under your direction being limited, I have used the best information I could obtain from a personal examination of the valley of the Chagres river between Cruser and Chagres, and a part of the route from Panama to the mouth of the Rio Obispo. As the entire distance from Panama to the mouth of the Rio Obispo has not been measured, I have assumed it at 195 miles, which probably will not vary more than two miles. The distances in the Rio Chagres are taken from a traverse of it, which I made by floating down the stream in a boat, taking the time of passing various places, and occasionally trying the velocity of the current.

The following table gives the distances from Panama to the mouth of the Obispo and thence along the Chagres river to its mouth :

TABLE OF DISTANCES.

			Total.
Panama to summit	9 miles	....	9 miles
Thence to mouth of Rio Obispo	10 "	....	19 "
" " Gorgona	3 "	....	22 "
" " a bad sand-bar above Palanquilla	6 "	....	28 "
" " Palanquilla	6 "	....	34 "
" " Gatun	23 "	....	57 "
" " Chagres	5 "	....	62 "

The elevation of the surface of the ground at the summit was given me by Mr. Baldwin's levels at 330 feet above tide. I have made my calculations for this route (the one examined), though by no means certain that it is either the cheapest or the best route, or even that the lowest summit has been obtained.

From Panama to the summit the surface of the ground is undulating ; a part of this distance near the summit, the rock is near the surface of the ground, and, though easy to excavate, it will render the line rather expensive. The remaining distance to the mouth of the Obispo is in the valley of the Obispo river, in an alluvial soil, easy to grade. The valley of the Chagres river will also be comparatively easy to grade, with the exception of a few points where

the hills crowd the route into the edge of the river. Of necessity the line will be rather crooked, but if a railroad be adopted none of the curves will be of so small a radius as to interfere with using locomotives.

There is necessity on this part of the route to have the embankments at least five feet above the highest known floods of the river, which sometimes in places rise 35 feet above low-water mark.

It is also necessary to have the whole line (if a road or railroad be adopted) well drained, and the bridges and culverts large enough to allow the great floods peculiar to the isthmus to pass off without doing injury.

The isthmus is so thinly populated that it is doubtful whether more than 150 laborers can permanently be obtained from the province at the ordinary rate of wages, viz., four reals Granadinos, or 40 cents a day. By raising the price to five reals, or 50 cents a day, 1,000 or 1,200 can be obtained from the provinces of Mumpox, Santamarta and Cartajena. If more are required it will probably be necessary to get them from some of the West India islands, and the price of wages will go up to six reals, or 60 cents a day.

The principal mechanics will have to be brought from the United States and the West India islands. Their wages, including all the expenses of transporting them, &c., can safely be taken at about double the ordinary price in the United States.

As the climate is always a hot one, and as the rainy season generally continues from the first of June to the first of December, and as during the remaining five months occur heavy rains, a man cannot do as much work there in a month as in the more temperate or dryer climates.

Taking all these circumstances into consideration, I have made an estimate of the cost of

I.—A ship canal from Panama to Chagres.

II.—A railroad.

III.—A plank road.

IV.—A turnpike or wagon road.

V.—A railroad from Panama to the mouth of the Obispo river, and making the Chagres river navigable by means of locks and dams to Panama, for steamboats 180 feet long, 48 feet wide (including wheelhouses), and drawing five feet of water.

VI.—A wagon road from Panama to the mouth of the Obispo river, and making the Chagres navigable as above.

I.—Estimate of the cost of a ship canal from Panama to Chagres, to pass vessels 350 feet long, 70 feet wide (in the clear), and drawing 24 feet of water:

19 miles of canal from Panama to the mouth of Rio Obispo, at $200,000	$3,800,000
15 miles of canal to Palanquilla, at $120,000	1,800,000
28 miles of canal to Chagres, at $100,000	2,800,000
60 locks, at $350,000 *	21,000,000
2 grand locks, at $300,000	600,000
Reservoirs and feeders to furnish the summit with water, say	2,000,000
Total	$32,000,000

N. B.—The canal to be, except in a few places, 250 feet wide on the surface and 26 feet deep.

II.—Estimate of the cost of a single-track railroad from Panama to Chagres:

GRADING.	
19 miles from Panama to the mouth of Rio Obispo, at $22,000	$418,000
42 miles from there to Chagres, at $18,000	756,000
SUPERSTRUCTURE.	
70 miles superstructure, at $12,000	840,000
Locomotives, cars, machine shops, depots, etc	186,000
Total	$2,200,000

N. B.—The distance for the railroad is put at 61 miles, or one mile shorter than the canal line.

III.—Estimate of the cost of a plank road from Panama to Chagres:

Grading from Panama to the mouth of Rio Obispo, 19 miles, at $4,000	$76,000
19 miles planked surface, 10 feet wide, 3 inches thick, with sleepers of 4 x 5, at $7,000	133,000

* NOTE.—Each of these locks will require about 23,000 cubic yards of hydraulic masonry. The estimate is for plain, strong, but not finely cut, stone work.

Grading, Rio Obispo to Palanquilla, 15 miles, at $3,000.	45,000
15 miles planked surface, at $7,000	105,000
Grading, Palanquilla to Chagres, 28 miles, at $3,000	84,000
28 miles planked surface, at $7,000	196,000
Total	$639,000

—say $650,000.

N. B.—The plank suitable for a plank road cannot be procured on the line of the road at this time for less than 50 cents to $1 each, as they are worked out by hand, and only a small portion of the population understand the business.

IV.—Estimate of the cost of a turnpike or wagon road from Panama to Chagres:

19 miles from Panama to the mouth of the Rio Obispo, at $7,000	$133,000
43 miles from there to Chagres, at $6,000	258,000
Total	$391,000

—say $400,000.

N. B.—This estimate is for a turnpike road to be graded generally 26 feet wide between the ditches, and gravelled except in a few places where gravel cannot be obtained; in these places to be covered with broken stone so as to make a good, but not a macadamized, wagon road.

V.—Estimate of the cost of a railroad from Panama to the mouth of the Rio Obispo, and of making the Chagres river navigable for steamboats from there to its mouth:

Grading 19 miles of railroad from Panama to the mouth of Rio Obispo (as before given)	$418,000
23 miles superstructure, at $12,000	276,000
Locomotives, cars, machine shops, &c	100,000
5 locks and dams in the Rio Chagres, at $90,000	450,000
Clearing banks of river in various places, &c	26,000
Steamboat wharf and warehouse at Chagres	30,000
Total	$1,300,000

VI.—Estimate of the cost of a turnpike or wagon road from Panama to the mouth of the Rio Obispo, and of making the

mouth of the Rio Chagres navigable for steamboats from there to its mouth:

19 miles turnpike from Panama (previously estimated)..	$133,000
Improving the navigation of the Chagres river (as previously estimated)...........................	506,000
Total	$639,000

—say $650,000.

The estimates are in United States currency, and I think are abundantly sufficient to do the work on their routes. It is possible that it may be done for 15 per cent. less; but it is not very probable that it could be.

All of which is respectfully submitted, by

Your obedient servant,

Barranquilla, July 5, 1848. HENRY TRACY.

ADVANTAGES OF THE SUEZ CANAL OVER THE INTEROCEANIC CANAL AS A ROUTE FROM THE UNITED STATES TO CHINA, INDIA, &c.; WITH TABLES OF DISTANCES.

By JESSE YOUNG, Corresponding Member of the American Geographical Society.

These tables, which are as correct as the limited means at my disposal will allow of, will serve to show the relative distances between England on the one hand and New York on the other, and the principal ports of India, China and Australia respectively—that is, for steamers; for sailing vessels, the courses vary so much at different seasons of the year that no correct general idea can be obtained. From both England and America steamers will call at Gibraltar, Malta, Port Saïd, Suez and Aden for Bombay, and Point de Galle for Madras, Calcutta, Burmah, Singapore, Hong Kong, Shanghai, Yokohama; from Point de Galle for Australian ports, via King George's sound, Adelaide, Melbourne, Sydney, and New Zealand, though doubtless the distance to Australia in the course of a very few years will be materially shortened by vessels calling at Port Darwin direct from Aden, or more probably Locotra island, rounding Cape Guardafui, and discharging their mails, &c., to be forwarded to their various destinations overland, thus avoiding the much dreaded Cape Lewin. The distance from Point de Galle to Port Darwin being 3,120 miles, it thus makes the distance to Australia from England 9,856 miles, against 11,381 miles to Melbourne via Cape Lewin.

For eastern ports via the Panama route, vessels will coal at St.

Thomas, Panama, Honolulu, Yokohama, &c.; but for Fiji, New Zealand and the eastern ports of the Australian colonies, steamers will probably have to steam the entire distance of some 7,000 miles without coaling; this will prevent their being able to carry very much freight. It will be seen by comparing the distances, that with the exception of Japan, New Zealand, Fiji and the eastern ports of China, and the west coast of the Americas, Europe will derive no advantages whatever from the interoceanic ship canal, all other ports being nearer via Suez. For south Europe, even China, Japan and Australia (via Torres straits), are nearer via Suez, but I have taken England as a point of departure for all, it being one of the remote countries of Europe. Moreover, East African, Arabian Indian, Burman, Malayan, Javan, some Chinese and some Australian ports are nearer for the American commerce via Suez, than by way of Panama, or whatever route on that isthmus may be selected for a canal. The great advantage which the Suez canal will have over the Central American route, for all commerce with foreign countries where a canal is used, is the all important requisite of being able to coal at short distances, thus enabling vessels to carry a large amount of freight, and to take in fresh cargo and provisions at the numerous stopping places; none of these things can be done when a ship has to carry such an immense amount of coal for her own consumption. The traffic for sailing vessels would be comparatively small, judging by the number which now rounds Cape Horn, as against the number of twenty years ago.

Following are the distance-tables:

APPROXIMATE DISTANCES FROM LIVERPOOL.

	Via Suez.	*Via Panama.*
To Hong Kong	9,670	14,943
" Melbourne	11,381	13,195
" Melbourne (direct from Cape Guardafui, without calling at Ceylon)	11,000	
" Point de Galle	6,736	16,347
" Port Darwin	9,856	14,200
" Yokohama	11,290	13,323
" Panama, direct	4,593	
" Melbourne, via Cape Horn	13,290	

FROM NEW YORK.

	Via Suez.	*Via Panama.*
To Hong Kong	11,620	11,489
" Melbourne, via Galle	13,331	9,539
" Point de Galle	8,686	13,693
" Yokohama	13,240	10,869

From	Panama to Honolulu	4,650
"	Panama to Sydney	8,000
"	Panama to Auckland	6,780
"	Panama to Fiji	6,240
"	Sydney to Fiji	1,693
"	Auckland to Fiji	1,095
"	New York to Gibraltar	3,250

STATEMENT BY COMMANDER SELFRIDGE, U. S. N., REGARDING HIS SURVEYS ON THE ISTHMUS OF DARIEN.

CHIEF JUSTICE DALY,

President American Geographical Society.

To the many communications on the subject of the piercing of the American isthmus that have appeared in the columns of your Bulletin, and in American newspapers, I have studiously refrained from adding, partly because I have never been officially connected with either of the present routes—Panama or Nicaragua—now prominent before the public, and partly because, from absence on foreign service, I have not had the opportunity of keeping pace with the discussion.

But in your issue of December 10, there appears a detailed report of a paper by Rear Admiral Ammen, read before the American Geographical Society, which might be styled a criticism upon the late International Congress, in which this gentleman goes out of his way to attack me personally; and, therefore, a further silence would be a tacit acknowledgment of his ungenerous remarks.

Quoting from the paper alluded to, Admiral Ammen goes on to say: "During the sitting of the Congress, I found myself frequently obliged to dissent from the propositions of Commodore Selfridge, U. S. Navy, who, *strangely enough*, was found in the Congress without being named by our Government." The impression evidently intended to be conveyed is, that I had no right there. No doubt my presence was strange enough to Admiral Ammen, and a surprise to one who seemed, by his own admissions, to have had a good deal to do with whom should be sent to represent the United States. Admiral Ammen knew when he wrote this that I was, like himself, a member upon invitation of the French Geographical Society, issued through Baron de Lesseps, and, as such, was his equal in all the discussions of the Congress. My presence might have been strange enough to him, but to a Congress gathered for a general discussion of the subject the absence of one who surveyed or had

been identified with all the routes covered by the Isthmus of Darien, would have been equally strange.

Admiral Ammen's insinuations that the Congress was gathered for an endorsement of the Panama route, is an insult to the many eminent men that composed it; and when it is remembered that of the two representatives of the United States both were avowedly in favor of Nicaragua, an inference equally uncharitable might be drawn.

The project of a canal via Nicaragua never stood any chance in the Congress, not because its opinion had already been manufactured, but simply because the idea is indelibly fixed in the majority of the French people that only a canal without locks can be a financial success, and Nicaragua does not admit of the construction of such a canal.

Many years ago, in a correspondence with Monsieur de Lesseps, he said to me frankly that no project which included the construction of locks could receive his approval.

Familiar with the Nicaragua route from the surveys of Mr. Childs, Commander Lull and Mr. Menocal, and with the Panama route from frequent passages across on the railroad, I have always been, and am still, of the opinion that the one known as the Atrato-Napipi is the more to be preferred.

In regard to my part in the Congress upon the discusssion of the latter, Admiral Ammen says: "I refer the curious reader to pages 66 to 70 inclusive, and to map 8, illustrative of the Atrato-Napipi as developed by Commander Selfridge. Nobody reading this report and referring to the drawings would suppose for an instant that the greater part of it was purely imaginary. It is delineated as an inclined plane, locks located, and sections given in figures! Between this fanciful presentation and the profiles made by Lieutenant Collins there is a very wide difference." Instead of this covert misrepresentation, Admiral Ammen should have had the manliness to tell the whole story. He knows the valley of the Atrato-Napipi was, previous to my visit, an unknown wilderness; that no maps or data were, or had been, ever collected. The survey alluded to was, therefore, as all surveys of an entirely new country must be, preliminary; and my plans were based upon such information as I obtained from this reconnoissance. He knew that entirely upon my representation the Hon. Geo. M. Robeson, then Secretary of the Navy, consented to send an expedition solely for the survey of the

Napipi valley, which, up to that date, time had not been afforded me to perform.

I had been many times to the isthmus, and, feeling that this service could be equally as well performed by Lieutenant Collins as myself, I asked that he might be ordered to take charge of it, and also requested that Lieutenants Eaton, Sullivan and Paine, able young officers, who had served with me upon all the previous surveys, might, with their consent, be attached to the expedition. I superintended its fittings, and Lieutenant Collins's instructions were drawn from memoranda suggested by my experience and knowledge of the route. The work was faithfully and ably performed by Lieutenant Collins and his associates.

Notwithstanding that the inception of a canal via the Napipi was mine own, that the peculiar characteristics of its construction had been worked out after long study, and correspondence with the first engineers of our country, Admiral Ammen, as then Chief of Bureau of Navigation, under the cognizance of which all surveys had been made, saw fit to ignore my previous participation in this work, and directed Lieutenant Collins to make out a report.

Then, finding that his obvious intention was to shut me out from any further connection with a route that I was the first to have explored, I procured all the data obtained by Collins, and, with the assistance of Lieutenant Eaton, made an entirely new calculation of the contents of the prism of the canal, and a change of location, as far as the last survey showed such to be necessary.

It was with a map and profile so prepared that I presented the Atrato-Napipi project to the Congress, taking care to lay before the "Commission Techinque," at the same time, the map and profile of Lieutenant Collins, and pointing out the only differences, which were in my avoiding a few of the elevations cut through by him, by straightening some of the numerous ox-bows of the Napipi, and availing myself of the low ground thus acquired. Admiral Ammen, who had never, if I am not mistaken, visited any portion of the American isthmus, except to cross at Panama, who lays no claim to be an engineer, has the hardihood to call these plans—based strictly, as he well knew (if he had taken the trouble to inquire), upon the information acquired by Collins—"purely imaginary and a fanciful representation."

In answer to such an accusation, flung out to the New York Geographical Society, of which I am a member, but unable, from

absence on foreign service, to contradict till long after it had been made, I must be excused, in defense, for inserting the remarks of Mons. Lofebrere de Fourey, the president of the second "Sous Commission Technique," and the senior engineer of the Congress, as taken from the journal of the proceedings, at his speech in closing the discussion: "The project by way of the Atrato is one that has been rendered very enticing by the devotion of the man who has more especially occupied himself with this question. [Applause.] I believe I am the interpreter of the commission in saying that Mr. Selfridge will carry away with him the admiration of the commission, [applause] and I do not for a moment doubt that the entire commission will agree to the words with which I have expressed my high appreciation of the beautiful work of Commander Selfridge. [Prolonged applause.]"

A comparison of the rival routes of Panama and Nicaragua can only be made by applying a similar construction (namely, with locks) to each, for Nicaragua does not admit of any other. As to the sea-level canal at Panama, it will be better to await the personal investigation of Count de Lesseps, with the French engineers, and of Colonel Totten, whose long familiarity with this route makes him an authority beyond all question.

As to a canal with locks, I have no hesitation in preferring Panama to Nicaragua. In that we have a length of canal navigation of 48 miles, offset by one of 124 miles, not including the transit of Lake Nicaragua.

The great obstacles at Panama are the floods of the Rio Chagres, and to avoid them it does not seem necessary to carry the summit level higher up than the station known as Barbacoas, which would be about 60 feet above mean tide, requiring six locks against the lift of 107 feet in Nicaragua. A strong feature in favor of Nicaragua is that there are no very deep cuts in the route, as proposed, from which, at the same time, the Panama line is not entirely free. This is more than offset by the amount of under-water rock excavation required for Nicaragua. Besides, when a canal does not interfere with the natural channels of drainage, I am of the opinion that danger from rains merely can be averted by not very costly expedients.

It is alleged that the rainfall of Panama is very much greater than of Nicaragua. In the absence of any reliable measurements for the latter, and considering the fact that Aspinwall and Grey-

town are but $1\frac{1}{2}°$ of latitude apart, it is doubtful whether the difference, if any, would be material.

In advantage of harbors, Panama is far ahead. No doubtful results attach themselves to the security of Aspinwall by a simple breakwater, while the same at Greytown cannot by any means be said. In the facility with which all parts of the line can be reached, and supplies forwarded, the Panama is immeasurably ahead. In one case, steamers would unload at the wharfs of Aspinwall, and in a few hours distribute their supplies over the whole line; in the other, till a harbor was dredged and breakwater made, supplies must be landed on the beach, then transported, in the absence of a railroad, by carts, or by light-draught steamers over falls, for a distance of 100 miles or more.

In compactness of line, involving greater economy in construction, Panama is much superior.

It is alleged, in favor of Nicaragua, that its Pacific terminus is 600 miles nearer San Francisco. While this is true, it is wholly offset by the additional time it would take for the transit by Nicaragua, while the eastern termini of both are about the same distance from New York or Europe.

Lastly, against Nicaragua, it has, I think, been a reasonable objection, that the western portion of the proposed route passes through the most active volcanic region at present known. Much more might be said, but I will not trespass any further upon you.

It is to be regretted that the partisans of these two rival routes cannot reconcile their differences, and form an international company, under the leadership of such men as General Grant and Baron de Lesseps, the pride equally of their countrymen, which would command the confidence of the world. Such an organization, sending out a corps of engineers committed to no locality, blinded by no prejudice, would arrive at a result which the future could give no cause to regret. THOS. O. SELFRIDGE, JR.,

Commander U. S. Navy.

U.S.S. "Enterprise," Athens, Greece,
Jan. 14, 1880.

OBJECTIONS TO THE ISTHMUS OF TEHAUNTEPEC AS A CANAL ROUTE.

Chief Justice DALY, *Pres. of the American Geographical Society.*

SIR,—At the time of the reading of my communication before your Society, Dec. 9, 1879, I invited its discussion by others interested in the question, and am glad that it has been considered

at several subsequent meetings held at the Society's rooms. The discussion has taken somewhat broader grounds than I anticipated, in renewing debate upon a variety of projected routes which have been considered at various times within our memory, and has thus drifted away from the two which seem to me to be under discussion at this time. As I could not be present at these meetings, and have accepted the courtesy of your Society heretofore in communicating most of my views to those interested in the question, I think it proper to continue to avail myself of it in thus communicating what appears to me to be a succinct idea of what is likely to promote, and what to prevent, the construction of a canal, at least by an American company.

For some extraordinary reason, the Isthmus of Tehuantepec is again presented as a possible line of canal construction, and a survey of it is again proposed. Yet we know that it has a summit level of 754 feet, and will require 140 locks, or *seven* times the number of the Nicaragua canal; it has a line of actual excavation of 144 miles, or more than double the distance on the Nicaragua line, and it has a proposed dredging of a river subject to floods for a distance of 35 miles.

It has also to draw its water by a feeder 27¼ miles long, requiring a dam 86 feet high to get the necessary elevation, having four tunnels aggregating 3¾ miles, and even then a deficient water supply.

By the report of Engineer Fuertes, of the Tehuantepec survey under Captain Shufeldt, page 26, the Corti river, at point A, Map No. 2, is stated as supplying 1,618 cubic feet per second, exactly the quantity required for the alimentation of the canal, as given on page 31. All the available streams were found to yield 2,113 cubic feet per second, or 490 feet more than required. He estimated the loss in the feeder filtration, evaporation, &c., at 550 cubic feet per second, thus making the delivery amount to 1,563 feet per second, making a deficiency of 55 cubic feet per second.

On page 31 he cites two examples of feeder losses. The St. Privé, 26,000 feet long, loses three-fourths of its water; if loss at the same rate should occur, no water would reach through the seventh mile. In the example of the feeder of Boulet, which is 56,000 feet long, if loss at the same rate should occur, the water would not reach through the fourteenth mile. In the first case the water would reach one-fourth the length of the proposed feeder, and in the second case it would reach one-half of its length.

He states, however, that the nature of the soil along the Corti, or

proposed feeder from it, is well calculated to prevent filtration, but in giving the different sections along the feeder, he mentions that some portions of the cutting and tunnelling are in shale and drift, or "humus and loose earth." In the fifth division there is a tunnel two miles long, which, he says, "can be easily excavated, the ground being very soft." On some portions of the feeder, he states the formation to consist of clay, sandstone, marble and compact limestone.

There are numerous proposed dams for the interception of small streams crossing the line, and an aqueduct 1,200 feet long. Throughout several miles of its course, the feeder is raised above the natural surface, a condition favoring a large loss through filtration.

The cost of locks at the same estimate of the Nicaragua route would be $50,000,000; of actual excavation, $45,000,000; of feeder on Panama route—none being required via Nicaragua—$25,000,000; then the excavations of the Coatzacoalcos river for thirty five miles would sum up probably $5,000,000. The estimated cost on the upper San Juan, and $5,000,000 more, as in Nicaragua, for harbors presenting the same difficulties, make a total of $130,000,000.

The commission appointed by the President, of which I was a member, instead of adopting the estimate of 25 per cent. of the engineer to cover contingencies on the Nicaragua route, thought it necessary to double the estimates, and that too where building materials of all kinds were abundant and convenient. There is still greater reason to double the estimate of the Tehauntepec route, making it $260,000,000, and that too, as is shown, *without a water supply* adequate, at least, during the dry season.

Another survey cannot materially change the summit level already determined; it cannot change the length of the canal; it cannot add to the water supply without an increase in the estimate; it cannot, by any means, change the relative disadvantages which unhappily exist in its comparison with Nicaragua. What then is the purpose —what the object of a survey? Certainly there is not the faintest hope of those who are informed that the conditions will be found materially different from the above statement, whatever the assertion may be.

The Nicaragua route has in canalization 61¾ miles; the remainder is either lake or slack-water navigation in a river not subject to floods; the water supply is twenty times more than could be used in lockage; the summit level of the canal, 107 feet, and of the divide between the oceans, 150 feet. The cost of the canal, as esti-

mated by the civil engineer, without an allowance for contingencies, was \$52,000,000, and the cost named by the commission, \$100,-000,000.

The Panama route was carefully located at the request of the commission, and a line located at an elevation of 123 feet above the ocean, which will probably require an increase of four or five feet, as shown by the flood of last November. The cost of the last-named route, on a common basis for labor and materials with Nicaragua, was more than 50 per cent. greater, and will, in fact, cost more than double to execute.

It would doubtless be interesting to the public, and advantageous, to have the two last-named routes passed over by able engineers, with the instrumental surveys in hand, to approximate the relative cost of execution. To include the Tehuantepec route would be to include what is simply impossible of execution, by reason of the physical conditions above named. The object could not be to hope to make a canal there, but simply to prevent its execution elsewhere.

At this time there are in Nicaragua two European parties who are asking a concession. In March last, one was agreed upon to M. Blauchet, and only lacked one vote in the senate to confirm it.

The problem then is, shall we place no obstacle in the way of an American company, and thus probably enable it to secure a grant, with the idea of only permitting tolls that would be liberally remunerative, or, shall we place these obstables in the way, and certainly throw the concession into the hands of Europeans, and allow them to impose their proposed tolls upon us ?

They may very well say that we are not *compelled* to pass through the canal ; it is simply optional whether we go that way or *via* Cape Horn. We cannot very well propose to dictate what these tolls shall be, at least, unless we do so in advance of the granting of a concession by Nicaragua, and even then it would seem somewhat pretentious, in view of our inability to support such a demand, either in reason, or by material force.

I may add, that the commission appointed by the President in 1872, which sent in its report in 1876, had all of the information thought necessary respecting all the region involved. In short, the only two routes worth looking at are Panama and Nicaragua, and then only to establish the relative approximate cost of execution.

DANIEL AMMEN,
Rear Admiral, U. S. N.

LIFE IN THE EGYPTIAN DESERTS.

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After an absence of nearly six years in the military service of H. H. Ismail Pacha, Khedive of Egypt, I have returned to the United States, with a vast and varied store of information upon the distant lands which I have visited, not as a mere tourist, but as an explorer, student and observer. It is my purpose to present this information to the American public, principally in the form of a series of lectures, the subjects of which divide themseles naturally and spontaneously into three distinct parts :

First, Antiquities of Egypt, viewed in connection with a brief synopsis of her ancient history, her temples, her ruins, her tombs, all of which I have visited, and of which I have brought back a complete collection of photographs and illustrations.

The second branch is Modern Egypt, as it has been made by Mohammed Ali and his successors down to the present day ; the people and their various races ; their religion and manners ; their customs of marriage and divorce ; their harems and the condition of their women ; their music, festivals and fashions; their laws and tribunals; the army, its officers and soldiers, drill and discipline ; all this illustrated by many views and portraits and types of the people, the women, the soldiers, &c., &c.

The third branch is Life in the Deserts, among the Bedouins ; distant expeditions in the remote provinces of Egypt, especially in the eastern desert, between the Nile and the Red sea, and the western desert as far as Kordofan and the frontiers of Darfour.

It is to treat of this last branch of the subject that I have the honor to address you to-night, in compliance with the courteous and

highly appreciated invitation of the distinguished President of your illustrious society.

I had at first intended presenting you with a connected narrative of my expeditions in the eastern desert and in Kordofan, but this subject alone is so voluminous that it would easily afford material for four or five lectures. I will therefore confine myself to a general description of those regions and the populations which inhabit them ; and as my time to-night is so limited I shall omit all but the most indispensable preliminaries.

I will first request you to cast your eyes upon the map of Africa. At its northeastern extremity is Egypt, with its dependencies.

The northern portion of Egypt is the Delta, a triangle of land formed by the Nile, and whose base along the Mediterranean is about 130 miles, with an equal altitude. Above the Delta, the cultivable area of the country reduces to the valley of the Nile, varying in width from a rare maximum of four or five miles down to a few yards only; all the rest of the vast space, east and west of the Nile (excepting some few oases), is *the desert.* As expressed by all eminent writers since the days of Herodotus, Egypt is the *gift—i. e.*, the creation, of the Nile. It is a rainless country. Vegetation stops just where the waters of the Nile cannot be brought by canals and irrigation, and the dividing line is as sharply marked as a gravel walk on a grass lawn. All beyond this is *the desert.* That which lies east of the Nile to the Red sea is the Arabian desert; that on the west, indefinitely, is the Libyan desert.

Egypt proper—the Mizraim of the Hebrews—El Masr of the Arabs—extends only to the first cataract of Assouan (the ancient Syené), in latitude 24° 7′. Between the first and second cataracts is a region which, with all the country south to an indefinite distance, was called Cush by the ancient Hebrews and Egyptians, Ethiopia by the Greeks, and Nubia by the Romans. Its inhabitants are called at the present day Nubians by the Europeans ; but the name given to them by the Egyptians is Barabras or Berberines. They are nearly black in color, but differ very considerably from the true negro race. They speak a language of their own, altogether different from the Arabic.

Above the second cataract (Wady Halfa), in lat. 22°, the country as far as Old Dongola (lat. 18°) is called Upper Nubia.

All the country south of Dongola is called Beled es Soudan, a denomination that you will find on most maps, extending from the Red sea to the Atlantic ocean, with the specifications of Eastern Soudan, Equatorial Soudan, Western Soudan and even Austral Soudan. In fact the name is merely a derivation from *aswad* (plural, *suda*), which is the Arabian for black. So that Beled es Soudan means simply the country of the blacks or—as we translate it—Nigritia.

Khartoum, in lat. 15° 30′ (nearly), is an important city of some 40,000 inhabitants, situated at the junction of the White and the Blue Niles. Southeast of Khartoum is the province called Sennaar, noted for its gum arabic, and east of Sennaar is Abyssinia.

West of Khartoum, on the other side of the Nile, is the province of Kordofan, extending approximately between the parallels of 12° and 16° N. lat., and the meridians 29° 30′ and 32° 30′ east of Greenwich. Kordofan is important to the commercial world for its large supplies of ostrich feathers, and especially of the best qualities of gum arabic.

West of Kordofan is Darfour, which was subjugated and made an Egyptian province by the arms of the present Khedive not more than four or five years ago.

Finally, extending south as far as the lakes Victoria and Albert Nyanza, and supposed to include them, at least in part, is the vast region called "Provinces of the Equator." The whole of the immense territory, beginning at the second cataract and extending as far south as he can stretch and enforce his authority, is now under the exclusive and absolute rule of Gordon Pacha, a colonel of engineers in the British army, well known to fame, who has been made Governor for life of these provinces, with almost absolutely independent powers.

As I have more than enough to do to describe the regions and the people that I have visited in person, I will call your attention to the tracks which I have left upon the map of Egypt.

My first expedition was from Cairo to Kenneh on the Nile by steamer, about 400 miles. Thence across the eastern desert to the ancient Græco-Roman city of Berenice on the Red sea, where I remained exploring the shores for three months. Thence I traveled

with many meanderings, exploring the eastern desert, and especially the region of the ancient gold mines of Wady Allaki, worked by the Egyptians before the Christian era. Thence I went to Berber on the Nile, then to Abou Hamed, and traversed the great desert of Korosko across the bend of the Nile. Thence I descended the river in dahabeahs, visiting on the way all the ancient ruins along its banks down to Cairo.

In my second expedition I went by water as far as the second cataract at Wady Halfa; thence proceeded by camels along the banks of the Nile to Dabbé, in latitude 18°. Thence I struck across to the southwest as far as El Obeyad, the capital of the province of Kordofan. During the course of this expedition, having been prostrated by a sunstroke and partially paralyzed, I was unable to proceed further than Obeyad, which I reached in what was supposed to be a dying condition. After lying there six months in helpless and intense suffering, I was transported 1,200 miles in a camel litter across two great deserts—first to Khartoum, and thence to Suakim on the Red sea, whence a steamer conveyed me back to Suez. This being the amount of my explorations, I make no claim to being a great African discoverer, but yet I trust that what I have seen and am now going to describe will prove of some interest to your society.

Let us suppose now that you are leaving Cairo with me bound on an expedition to the eastern desert. We embark in mid September on a government steamer, with a detachment of Egyptian infantry and a couple of Arab staff officers. We pass through the draw in the splendid iron bridge, and in a few minutes we are stemming the powerful current of the Nile, which is still quite high at this season. Seated on deck under the awning, sipping the delicious Arabian coffee and inhaling the fragrance of Turkish tobacco, we see the varied kaleidoscope of the Nile unfold itself before our wondering eyes. Sometimes the valley expands like a green carpet on either side, with its rich harvests, its whitening cotton, its green sugar-canes and waving palms, in the midst of which sits embowered here and there a native village, with its quaint pigeon-houses and its lonely minaret. Further up, under the fig-trees and mimosas, shines in the magic moonlight of Egypt the white dome which

covers the tomb of a Mussulman saint. As we pass the villages at sunrise and sunset we see long files of veiled women in their dark blue robes, their water jars gracefully poised on their heads, coming down to fill them at the river bank, and then walking away with a grace and stateliness astonishing in mere peasants. At other points the utterly barren hills of the Arabian and the Libyan chains come down to the very water's edge, and naught is to be seen but the most dreary and desolate desert, without a blade of grass or a sign of human or animal life—nothing but the rugged red or yellow cliffs, with the heated air visibly quivering on their surface under the fierce rays of the African sun. Then, again, on one shore or the other, sometimes on both at once, the mountains recede for a mile or two, and as the panorama unrolls itself before us we see majestic temples and ruins, pyramids and obelisks flitting before our fascinated gaze, to be succeeded in turn by the huge and prosaic chimneys of some of the Khedive's great sugar refineries.

But I have no time to dwell upon this Nile picture, charming as it is to my memory.

We will now suppose that we have reached the terminus of our water journey at Kenneh, on the east bank of the Nile, 400 miles above Cairo. We land our soldiers and baggage and pitch camp close to the shore. The governor comes down with his suite to do us honor and to invite us to a grand Arab dinner, to be followed by a fantasia or exhibition of Ghawazees, the dancing girls for which this place is famous. I could easily fill up all the rest of my time with this festival alone—so peculiar—so different from all our ideas and customs, but I must pass on.

The next thing in order is a conference with the sheikhs of the Bedouins, who are to be our " friends, counsellors and guides " (especially the latter) across the eastern desert down to Berenicé on the Red sea.

We are seated on camp stools in the large headquarters tent—a French-speaking Arab staff lieutenant on each side, to act as interpreters. In stalk the Bedouins, one by one, eight or ten of them. Each one makes a grave and dignified salute. " *Naharek saïd ya Bey !*" with the accustomed gesture of the hand, carried to the heart, the lips and the forehead (*temeeneh*); then he squats down

on his hams, cross-legged on the ground, and removes his shoes. Proceedings begin with coffee and pipes—the invariable preliminary to everything. These disposed of, business begins. The sheikhs have been notified long beforehand by the governor, who had received his orders by telegraph. So they are ready with their men and their camels, and the point now to be settled is the number that we will want.

They examine the baggage, count the boxes, tents and other impedimenta, and name the number of baggage camels needed. But the great question is that of water—what is the supply on the route, how far apart are the wells, how many men have we, and consequently how many water camels must we take.

The sheikhs naturally want us to take the largest number possible, as they receive a percentage upon all the moneys paid to their people. After much discussion, we settle down to fifty water camels, beside the baggage camels and the *hageens*, or riding dromedaries, for the use of the officers and the principal guides. There is to be one driver for every four camels, and the price already fixed by the governor is half a dollar a day for each animal, including the wages of the drivers, who are, moreover, to supply their own food and water, for the supply carried by the fifty water camels is exclusively for the members of the expedition.

Here I must stop and explain. The moment we leave the banks of the Nile, we enter a world entirely strange and new—a waterless land, without rivers, creeks, rivulets, or springs; nothing but scanty and more or less brackish wells, at long intervals, and in the mountainous regions, some natural rocky reservoirs, where the rare rain-water collects in the brief and uncertain rainy season. I will state here by way of illustration, that when I crossed the eastern desert in the fall of 1873, there had been no rain for three years. So that the first thing to be provided in starting is a supply of water sufficient to last from the Nile to the first well, and then from each well to the next.

This water is carried thus: The natives employ exclusively goat and ox-skins. When a goat is killed, they cut off his head and his legs at the hocks and knees. They split the skin down his breast to the least possible extent, and then they just turn him out of his

jacket by pulling it off like a stocking. The hide is immediately cured in a way that keeps it supple, and it is turned again with the hairy side out, the legs are tightly tied up, leaving the neck open, and thus you have a water skin, or *girbeh*, as they call it, holding from six to ten gallons, according to the size of the defunct goat. The neck is then tightly tied with a string. A strap connects the fore and hind legs, and by this strap the girbeh is suspended to the pack saddle. The hair and even the tail remaining undisturbed, the girbeh looks like the bloated corpse of a drowned goat. These are the water bottles of Scripture, used on those deserts since long before the days of Abraham; and they are very good things too ; for after a few days' use, a skin keeps the water very sweet, without imparting the least leathery taste. The only objection to the girbeh is that it is apt to wear in holes where it rubs constantly against the pack saddle, and that it loses water by evaporation under the fierce sun rays, so that your water may not hold out according to your calculations. Ox-hides, treated very much in the same way, are called *ryes* and hold water much better. But military trains are supplied, in addition, with flattened zinc barrels, whose shape is adapted for hanging to the pack saddles. They have screw stoppers which prevent all leakage and evaporation.

You may well believe me, that no one can fully appreciate the priceless value of water until he has been in a waterless land, where, to find that the well which he had relied upon has gone dry, may mean death in one of its cruelest forms. There, the Arab abstains even from his religious ablutions before prayer, for his law permits him in such a case to wash his hands and feet with sand. We officers always managed even in the most desolate deserts to have a small basin full morning and evening to wash the sand and dust out of our eyes, but even that was too precious to throw away after using, for there was always at the tent-door some poor sheep or goat of the caravan, attracted by the sound of water, and too glad to drink it to the last drop. Even in Kordofan, where the population dwell in permanent abodes, the natives never wash, and the cattle, donkeys and other domestic animals are watered only once in two days. You would not wonder at this if you could see the enormous amount of labor required to draw water from wells

from 100 to 250 feet deep, with no other means than a sheepskin holding about a gallon by way of bucket, drawn up by a rope which has to be pulled up hand over hand, without any pulley or windlass. Add that, as a general rule, the water is bad—the exception being when it is worse. It is only at rare intervals that you find a good well, or, better still, a natural rocky reservoir of rain-water in some mountain gorge. The first thing on arriving at a well is to taste its water, and every one takes a sip, rolling it in his mouth and testing it, as epicures do rare wines. Great is the joy if it is pronounced "*moya helwa*," sweet water; but when the guides say "*moosh tayib*"—not good—you know it is a strong solution of Epsom salts.

To finish with the subject of water, whose importance is my excuse for dwelling on it so long,—when carried in the girbehs in the sun, it gets quite warm, and that in the zinc barrels almost boils, but as soon as one gets to camp, it is poured into gazelle skins or into leather cans, called *zemzimiehs*, which are hung on tripods in the shade. In half an hour, by evaporation in the breeze, the water becomes drinkable, and by midnight it is as cold as fresh spring water. In the morning, at starting, if you hang your zemzimieh on the shady side of your camel and throw a blanket over it, you will have drinkable water all day.

Yet I can assure you, that when I was lying ill for months in an Arab house in Kordofan, with nothing to drink but the tepid and ill-tasting water of that region, my imagination dwelt continually upon the cold crystal springs of the Alleghanies, and I thought if my life were spared to return to America, I would devote a good portion of it to drinking water.

Equal in importance with water is the subject of the camel, and I could fill a good sized book with all the interesting points of this wonderful creature.

You have all seen some very poor specimens of this animal in the zoological collections, but you know little of him but his ungainly and unsymmetrical appearance—his gawky and lumbering gait. Those you have seen were most probably the Tartar or Syrian camel—some with one hump, others with two, with large frames, big heads and necks, coarse legs and long hair, adapted for protection against the cold winters of Syria, Persia and Tartary.

Having traveled and hunted on a camel's back some five or six thousand miles, I think I have become sufficiently acquainted with all his characteristics to edify you completely on the subject.

Well, take him all in all, he is the most wondrously curious animal that God ever made. He has been called the ship of the desert, and he is emphatically so, for without him it would be as impossible to cross the great waterless deserts as to cross the ocean without vessels.

There are various breeds of camels as there are of horses, and Arabia has produced the best races of both these animals. The Arabian camel, which is used in Egypt and the African deserts, differs greatly from the Bactrian or Tartary camel. He has but one hump, and seldom exceeds nine feet to the top of it. His proper home is the desert. Transplanted to the rich lands of lower Egypt, he degenerates in consequence of too abundant food and of being watered every day. It is true that he becomes larger and coarser, but he loses his most valuable quality, that of being able to live on little food and of passing many days without any water at all.

The best breeds of Egypt are raised in the eastern deserts by the Ababdeh and Bishareen tribes, with whom I will make you acquainted presently. Their prevalent color is reddish, dun or white. The head is small, the neck rather slender, and the hair is very short. The camel and the dromedary are the same animal, differing only in breed, as the carthorse differs from the racehorse. The burden camel (called *gamal* by the Arabs) is coarser, heavier and slower. His gait is a walk of two and a half miles an hour, regular as a clock, under a load which should never exceed 400 pounds on a long journey. He corresponds to the dray or carthorse. The riding camel, called dromedary by Europeans, and by the natives *hageen* (g, hard), corresponds to the saddle and racehorse.

There are breeds of camels whose pedigrees are traced to renowned ancestors one or two hundred years back, just as we trace our race-horses to the Godolphin Arabian, or to Flying Childers. These high-bred hageens bring fancy prices. The riding camel, or dromedary, as we will call him, since that name has prevailed, is distinguished by his small head and ears, slim neck, and especially slender and wiry legs. A good dromedary, with no load but his

rider, water skin, and a little food, may travel 100 miles a day for four or five days without injury. On an emergency he can go 150 miles in one day, but he will probably be worthless afterwards. The Bedouins keep a complete "turf register" in their traditions. Two of the most renowned ancestors of their best breeds are a male named Herefi, who went 175 miles in ten hours, and a female of the stock of Couberee, named Fagra, who went 230 miles between sunrise and sundown, without sustaining the least injury. Running a short race, a swift dromedary can make his mile in 2 min. 15 sec., without galloping, for, in fact, his pace is swifter than his gallop. Almost the only way the Bedouins hunt the gazelle and the ostrich is by running them down on their swift dromedaries.

You have no doubt heard and read about the intolerable gait of the camel, and its causing backache and seasickness, and all that; these are the impressions of those who don't know how to ride him. I can assert, from my own experience, that any one accustomed to horseback riding can, with proper directions, learn in one day how to ride and manage the camel. He is the most docile and manageable of all animals, excepting only the Egyptian donkey. He is held and controlled by a halter only, though sometimes a spirited animal requires to be held by a leather thong attached to a ring inserted in his nose. After you once master the art of mounting and dismounting, you have no further trouble.

To be loaded or unloaded, mounted or dismounted, he is made to kneel down flat on his belly. To make him do so, you have only to give two or three jerks with the halter, accompanying the act with a rasping sound of the palate, which they are taught to understand from their earliest youth. The saddle, very broad, with a horn about a foot high in front and rear, is firmly fixed on his hump so that it will not slip either backward or forward. You sit on it woman-fashion, hooking your right knee over the front horn, and putting your left foot in a stirrup; while you are doing so, your attendants are keeping him from rising, for otherwise his invariable habit is to rise the moment he feels the first pressure of your weight, and it requires a great deal of practice to be able to mount a dromedary without his being held down until you get your seat. Now is the trying moment for the novice. The camel rises in three motions—first, he rises to his knees only, and that makes

you naturally lean forward ; but the second motion is to rise the full length of his long hind legs, which, in a well formed camel, are longer than his fore-legs, and unless you lean well back just at that moment, you will be shot over his head as out of a sling—and many are the tyros whom I have seen served just so ; the third motion is to rise to his fore-feet.

To dismount, the process is the reverse. Having first stopped him, you utter the sound described, jerking the halter and touching him gently on the neck with your stick or courbash. A well-broken dromedary obeys the signal at once, though never without growling. Now, look out ! He drops on his knees and you must throw yourself well back ; second, he folds his hind legs under him ; third, he comes down flat with his fore-legs, moving his knees a little further forward to make room for his long hind legs.

The mechanism of these movements is easily learned in one march by a practised horseman, and, after two or three days, he is just as much at home on a camel's back as he ever was on a horse. Yet I have been astonished, in reading accounts of Eastern travel, to find how few acquire the simple art of easy camel riding, which consists chiefly in not permitting your camel to move at a walk.

But there is one thing one must always guard against—it is the sudden *flopping** down of his camel, for the latter has his fits of ill humor, which manifest themselves chiefly in that way. If the saddle feels uncomfortable to him, or if you want him to turn aside from the beaten track or the company of his fellows, down he goes like a flash, and roaring like a lion, shooting you over his head if you are not looking out. You whip him up again, but if he is obstinate he will flop down five or six times in succession before submitting to go your way. This presentiment of his going to flop down becomes a matter of instinct. I can't tell exactly how, but I always felt a second before when my camel was going to flop, and I never went over his head, certainly not more than once or twice, at the beginning of my experience.

I need hardly add that, if you are in a hurry, you can jump down

* A word used by Dickens, neither classical nor elegant perhaps, but more expressive than any other I can find.

without even halting, easing yourself down by holding to the pommel with your right hand.

Next to mounting and dismounting is the art of making your dromedary move in the right gait. As to guiding him, a little child can do that. But the secret of comfortable camel riding is to never let him *walk* a single step, except in deep sand or steep rocky ground, where you cannot help it. There is not a more back-breaking and skin-abrading motion than a camel's walk; but if you press him into a gentle pace, which is the natural gait of a dromedary, he moves both legs on the same side together. Thus he will go all day, with perfect ease to you and no fatigue to himself, at the rate of about five miles an hour. In that gait his motion feels exactly like that of a very easy trotting horse—though, of course, camels are like horses, some moving easier than others. With every increase of the rapidity of his gait he goes rougher. I have seen Bedouins racing at the rate of 25 miles an hour, but none but Bedouins could stand such bouncing, and even *they* find it impossible to sit a dromedary at full gallop without holding on, like grim death, to the horn of the saddle.

I always pitied those poor devils who had to ride burden camels or stay with the caravan. Not only do they suffer from the horrible motion, but they have to remain in the saddle double as long as we who ride dromedaries. This is the way we do it: we start after a light breakfast, just as soon as it is light enough to read the compass and the aneroid. We take with us our staff-officers, orderlies and a couple of guides, leaving behind the baggage camels, which are being loaded. We go off at five miles an hour until about 10 o'clock. Then we stop, have coffee made, eat lunch, and take a nap if there is any shade. In the meantime the caravan catches up with us and passes us. We let it go on, and after awhile we mount leisurely, overtake it and pass it again. After a couple of hours or more, we halt again for more coffee; then we remount, and arrive at the camp-ground either before or after the caravan, just as we find most convenient. Thus, if we have kept the straight road, we will have been in the saddle only eight hours instead of sixteen, which is a long march for burden camels. As I never had occasion to travel without my caravan, I never was in the saddle more than 10 or 11 hours a day, including all the detours I would make for the purpose

of hunting and exploring, and having had much experience with horses and camels, I will say, that if one has to be in the saddle all day, a good dromedary is a better mount than a horse. He carries you with less effort, and on the broad saddle you can change your position, sitting on the left, then changing to the right side, or riding astraddle as you feel inclined. The Bedouins prefer a saddle with a seat like a big square tray, in which they are enabled to sit cross-legged, which seems to be such an important element of oriental felicity.

I come now to those peculiar qualities which give the camel his chief value. In his hump he carries a provision of fat which enables him to withstand the privations of the desert, and it is always important to see that your camel's humps are plump at the start, for they will all melt away before the end of the journey. Naturalists tell us that he has several cells in his stomach, in some of which he carries a supply of water sufficient for five or six days, even in the fiercest heat of summer. But on the fifth day he begins to suffer, and some of the weaker ones drop down suddenly, refuse to rise again, and in a few hours are food for the vultures and hyenas. Strange to say, when, after five days' march without water, he reaches the wells, he does not drink much, nor greedily, and the drivers have to coax him and make him return several times to water to make him absorb enough for the next five days. During the interval between one watering and another, you will at times hear a gurgling sound in the camel's throat, and if you look in his mouth you will see what seems to be an elongated bladder all swelled up with the water which he is forcing up from one of his internal reservoirs to swallow it back into his true stomach. You know it sometimes happens that Bedouins, whose water skins have burst, kill their camels to get at the water, which is found perfectly good in the bags which nature has provided for it.

Well, the camel is as abstemious in regard to food as to water. His natural food is the herbage found in the desert wadies where the waters flow during the brief rainy seasons, and he prefers above all things the twigs and foliage of the African accacia or mimosa, with its thorns two inches long and hard enough to be used as pins. You see him go up to these trees and bite off greedily the ends of the limbs. It is to be supposed that the thorns tickle his tongue

and palate pleasantly, as mustard does ours. If the caravan is travelling through good wadies, the burden camels, spreading out to a front of 100 yards and more, graze along as they go, without altering their gait of two and a half miles per hour.

I have told you of all the camel's good qualities. He has a few which are not agreeable. He is horribly ugly, gawky and ungainly, and his odor is not of "Araby the blest," though he comes from there. It is true that he is submissive and docile, but he never exhibits affection, and he will never permit any fondling or familiarity. He bellows and roars upon the least provocation, and his roar is like that of the lion. Whether you want him to halt or to move, to lie down or rise up, to load or unload him, to mount or dismount, he roars. If you raise your hand to put a coat or blanket on him, or even to caress him, he roars, and while doing so he writhes his long snaky neck, turning his head towards you, frowning his heavy eyebrows with an almost human expression, and opening his great jaws, with teeth like knife-blades, and he seems fully able and quite willing to bite off your arm at one single snap. Yet, with all this show of fierceness, he is harmless. Many and many a time I have had over 500 camels in my caravans, and out of the whole number there would not be more than two or three which had to be muzzled, and that mainly to keep them from biting their fellows. Only once, in all my experience, have I known a man to be bitten, but then it was frightful. Now, just think how many kickers and biters will be found in every regiment of cavalry, and you will agree with me that the camel is much more gentle than the horse. He is also much more stupid, and his stupidity increases his usefulness, for if he had as much sense as the horse or the mule, it would be impossible to turn him loose to graze about at his own sweet will, for he would immediately make a bee-line for the last watering place. As it is, he never wanders from the neighborhood of the camp, and he allows himself to be caught and driven in without any trouble. We know by the fossil bones found all over the world, that the camel existed before man. But while at the present day all the other domestic animals are found somewhere in a wild state, I do not think that the camel is; and I am very sure that in the deserts of Africa he would promptly perish without the care of man.

Such, then, is the camel—obedient, patient, enduring and sober. Carrying on his back water that he may not drink, and food not for himself, his soft, broad foot enables him to traverse sands where the horse would sink above his knees and would promptly perish from thirst; and he is equally sure-footed in rocky and mountainous grounds, but perfectly helpless on muddy and slippery ground. Not only have I ridden him and hunted on him thousands and thousands of miles, but when prostrated by disease and unable to sit erect, I was transported 1,200 miles across two deserts, from the centre of Kordofan to the Red sea, in a litter borne between two camels. They never shied, never stumbled, never varied their equal step the whole way; and to this useful and much enduring animal, than which none other could have transported me so, I am indebted for returning alive from those burning and malarious regions. You must therefore excuse me if I have dwelt too long upon his characteristics, and yet I have been compelled to omit many very interesting details. I will conclude the subject of the camel by adding that he is broken to use at the age of three years, and that he lives about thirty years. Camel's milk, which is equal to cow's milk, is the chief resource of the Bedouin tribes, and when they can no longer use him otherwise, they *eat* him. But with all my desire to praise him, and although I have tasted him under the most favorable circumstances, when he was young and fat and killed for a great feast, I cannot conscientiously recommend *filet de chameau* as an article of diet.

You are now fully informed as to the water supply and the transportation on the desert. The next topic is the people who inhabit it.

We have already had a brief introduction to the Bedouins of the desert. I must now tell you who and what they are, and this compels me to say a few words on the much tangled subject of races in Egypt. In no country on earth is blood as much mixed as it is there, in consequence partly of many successive subjugations and chiefly of the introduction into the harems of female slaves from all countries, from the blonde and fair Circassian and Georgian to the bronze-colored Abyssinian and the unmitigated negress from Central Africa. The population of Egypt proper amounts to about five and a half millions; of these, four and a half millions are

Mussulman Fellaheen and another half million are Copts. But these two are of the same stock, being the descendants of the Pharaonic Egyptians. They are the autochthonal race of Egypt, subjugated by the Arabs, as they had been before by the Persians, the Greeks and the Romans. The chief difference between the Mussulmans and the Copts is that the former intermarried more freely with the Arab invaders and adopted the creed of Islam, while the Copts kept their blood unmixed and adhered to a strange form of Christianity, which permits polygamy and prescribes circumcision. They are inferior in size and physical development to the Fellaheen, and they exhibit, like the latter, precisely the same type of features and form that we find represented upon the ancient Egyptian monuments. As you ascend the Nile, the population become darker in complexion. The inhabitants of Nubia, called Barabras, are nearly black, but not negroes. They are the descendants of the ancient Ethiopians. Beyond the limits of Nubia, in the Soudan, negro blood begins to show and, as you go further south, to predominate. But it is a very different type from the negro race of the western coast of Africa, which supplied America with her slaves.

In 1517 the Turks, under Sultan Selim I., conquered Egypt, and have ever since held it under their domination. But the Turkish population of Egypt hardly exceeds 40,000. They are distinguished by their fair English-looking complexions, having frequently blonde or red hair. They are a handsome and proud race, and are thoroughly detested by the Arabs, whom they have conquered and oppressed. The Khedive and his family and many of the great pachas are of more or less pure Turkish blood. To these elements must be added 90,000 Jews, Abyssinians, Syrians, Armenians, &c., and about 100,000 Europeans.

But the race which inhabit the deserts are different from all those others. They are the Bedoween or Bedouins, and are undoubtedly descendants of Ishmael; they represent the true Arab race and retain its peculiarities; in fact, in the Arabic language, whose plurals are so queerly formed, *arab* is the plural of *bedawee* and is the name of the inhabitants of Arabia proper, Arabia Petrea being called *Yemen* and Arabia Felix *Hegaz*. It is true that in common parlance the great bulk of the inhabitants of Egypt are called Arabs and Fellaheen, but it is a popular and not a strictly

accurate use of the name. The nomadic tribes of the desert are always called Bedoween. They are subdivided into tribes too numerous to mention. Those west of Egypt, along the Mediterranean shores, are called Mogrebins. Those inhabiting the eastern deserts, between the Nile and the Red sea, between latitude 29° and 17°, are the Ababdehs and the Bishareens. West of the Nile are the Hassaneeyehs and the Kababish. These four tribes have almost identical customs and differ chiefly in peculiarities of dialect and modes of wearing the hair. The most important by far are the Ababdehs, who are probably the parent stock of the rest. They claim to be the original occupants of the land, and their ancestors must have crossed over from Arabia centuries before the Christian era, for Pliny, in the first century, calls the inhabitants of this region Gabadeh, a name differing but slightly from Ababdeh. They are all nomads, and roam those regions which are unfit for settled habitations because of the scanty and uncertain supply of water. Their wealth is in flocks and camels. They are carriers and camel drivers, but no consideration can induce them to work the ground. They often suffer from scarcity, which they could avoid by taking up unoccupied and fertile lands on the banks of the Nile. But the freedom of the desert is more precious to them than the plenty of the settlements, and they look down with unutterable scorn upon the Fellaheen and the inhabitants of towns, whom they call contemptuously "dwellers among bricks." Their condition at the present day is very much like that of their ancestors in the days of Abraham and Lot and Ishmael, and their customs have changed but little since that time. Each tribe is governed in an absolutely patriarchal way by its sheikh, a name which in Arab countries means a head man or chief.

Of course there is an immense difference between the sheikh of a hamlet or the sheikh of your guides, and the great sheikh of a tribe like the Ababdehs and Bishareens, which number together about 70,000 souls.

An incidental remark by the way. The game of chess comes from the East, and the Arabs knew it before us and practice it still. The expression checkmate, which sounds like pure Anglo-Saxon, is a corruption of the French *échec mat*, which is itself only the Arabic *sheikh maut*—the sheikh is dead.

The great Bedouin tribes were not reduced to obedience to the Egyptian government without long and fierce struggles. It was the iron hand of Mohammed Ali that forced them to submit. But even now the only mark of their subjection is a sort of feudal homage. Though the only warlike race in Egypt, they are exempt from conscription. The government never interferes with their internal affairs. They are under the direct rule of their sheikh, who appoints subordinates. The great sheikh of the Ababdehs is a vassal of the Viceroy, who requires him to reside habitually on the Nile, and holds him responsible, with his life and property, for the police of the desert ; in compensation for which he receives certain road dues from every caravan. So well does he perform the duty of maintaining police security of travel in the deserts, that you must not tax me with a satirical intention when I say, with perfect truth, that it is much safer to travel there with jewels and money than to display them at noonday on the Fifth Avenue.

While the individual members of a tribe have no separate possession in the land, yet the territorial limits of every tribe and sub-tribe are well defined, and the encroachments of a tribe upon the range and the wells of another give rise to many a bloody feud. Each tribe guards jealously the privilege of being the only guides and carriers across its own territory; and even the government sending expeditions through the desert is obliged to employ the guides and the camels of the country, paying them a fair retribution in cash.

These Bedouins nearly all speak Arabic, but they have also a language of their own, which is entirely different. They are rather above medium height, very well made, with small extremities, and the arched foot and high instep which are peculiar to the Arab race. Their color varies from bronze to nearly black, but their features are entirely European, and I have seen among them as fine profiles as in any race in the world. Their noses are aquiline, resembling the best Hebrew types. Their lips are thin and their teeth splendid. They have but little beard, and their hair is frizzled but not at all woolly. The girls and young women have often really beautiful features, and in form are like bronze Venuses, but they lose their beauty early in life and become hideous hags. They wear no veils, and their only dress is a few yards of cotton, formerly white, rolled

around the waist and hanging to the knees, leaving all the upper part of the person exposed; though sometimes, when it is cool, one end is thrown over the shoulder. As a general rule they are not secluded as in the settlements, and they came continually to our camps to sell chickens, eggs, milk and sheep; at such times they chatted freely with the soldiers and camel-drivers, but nevertheless they were said to be very strict in their conduct, for otherwise their lives would promptly pay the forfeit.

The philosophers of the eighteenth century wrote much nonsense about the pretended men of Nature, without artificial wants. These Bedouins would have nearly realized this ideal; but, fortunately for themselves, they differ from it more and more each generation; and under the influence of commerce they will acquire, from age to age, those artificial wants which are the great motors of human progress. Those races which have none but the lowest physical wants cannot rise in the scale of humanity; and it is precisely this absence of wants which prevents the advance of savage races in Africa and elsewhere.

Yet it is interesting to observe the modes of life in a desert country, where at first glance it would seem that existence is almost impossible.

The Bedouin is the most abstemious of men. His food is the yield of his flocks, and a little grain which he obtains by bartering their increase on the banks of the Nile, or with the caravans of merchants that cross his deserts. He also prepares skins and charcoal for sale. The mildness of the climate is such that he needs no clothing except a few yards of white cotton, which he winds around his loins. The desert grasses supply him with mats for his tent; the trees furnish him with pack-saddles, ropes and the tan bark, with which he dresses the skins that he uses for his milk and water. All that he wants besides are straight and broad sabre blades of German manufacture, to which he adapts handles and scabbards. He sometimes owns an antiquated matchlock or flintlock musket of the most absurd pattern. Nearly all carry lances made in the country, and whose heads are frequently barbed with the most cruel and elaborate ingenuity. Many of them have shields of giraffe or hippopotamus hide, and curved knives, like pruning-hooks, fastened to their forearm. The Bedouins make it a point of honor to carry

arms habitually. After a quarrel which arose between my soldiers and the camel-drivers, in the course of which the latter had drawn their sabres, I deprived them of their arms. But just before reaching some wells, where they expected to meet other Bedouins, they sent me a deputation earnestly praying the return of their arms, saying that they would be disgraced forever if forced to appear without them.

When a family, or a group of families, of Bedouins have exhausted the pastures of a wady, they remove to another within the territorial limits of their tribe. Having no other furniture than a few skins and gourds and perhaps one or two soapstone vessels, their migrations are exceedingly prompt and easy. The tents and other baggage are loaded on camels, and in a few minutes a whole encampment disappears. Although remarkable order reigns on the deserts, the habits formed by centuries of disorder are not yet effaced. When two parties meet (except on the great avenues of trade) both halt and send out a man or two on foot to reconnoitre. This precaution is rendered necessary in order to ascertain, among other things, if there is *blood* between the two parties, for the custom of the avenging of blood, such as known among the ancient Hebrews, exists here to the present day, and there are no cities of refuge. Their internal quarrels, of which the Egyptian government takes no cognizance, generally arise about wells and pastures and the theft of animals. Two parties come to blows and a man is killed; the murderer flees to his tribe and offers the price of blood. If this is refused by the family of the dead, war begins between the families, and the friends and relatives of each are soon drawn into it, and it may continue for years, each murder by one side requiring retaliation by the other. This trait of their character will be better illustrated when I speak presently of their great Sheikh Mohammed Khalifa, who was my friend and companion on my first expedition. When a caravan arrives unexpected in the neighborhood of an encampment, especially if there are soldiers with it, the first impulse of the natives is instantly to vanish. The flocks of sheep and goats, driven off by the women and children, disappear promptly behind the next ridge. Only after this precaution one or two men advance to reconnoitre, and when they have ascertained the peaceful intentions of

the newcomers they return promptly to trade and to hear news, of which they are very greedy.

Some Bedouins possess considerable wealth in flocks. In the eastern desert I met with a sheikh named Kindou, who was a grown man at the time of the French invasion in 1798, and who was consequently nearly 100 years old, though the natives said a great deal older. He had owned over 1,000 camels before that three years' drought, which killed nine-tenths of them. He made several days' journey with us as gaily as the youngest, and once he challenged me to a dromedary race with him.

The Ababdehs, Bishareen and Kababishe, as well as the Baggara, always go bareheaded in the fiercest heat of summer, and the two latter tribes, strange to say, shave their heads in addition. The Ababdehs twist their hair into plaits the size of a quill, which they throw straight back from front to rear. But the Bishareens arrange it differently. All the hair from the forehead to the crown of the head is combed straight up to the height of five or six inches. The rest hangs down in small plaits of the same length around the neck, nearly to the shoulders. They plaster their hair with suet and tallow, and any other grease they can procure. On a cold morning a Bishareen's head is white with the hardened tallow and resembles exactly the frizzled and powdered horse-hair wig of an English judge. But as the sun gets hotter and hotter towards noon, the grease melts and flows down to his shoulders and breast, producing infinite beatitude. This is an additional reason why the natives never wash. Water is too scarce, it is true, but above all grease is too precious to be wasted by such nonsense. This description applies to the great mass of these people, the vulgar herd. The great sheikhs have adopted the turbans and the rich and flowing oriental robes of the Egyptian Arabs.

Here I will introduce to you the head Sheikh of the Ababdehs and Bishareens, Mohammed Khalifa, and a sketch of this personage will illustrate the manners of his race.

He traces his lineage back for untold generations—to the days of the Prophet and beyond. He is the patriarchal, but well-nigh absolute ruler of more than 60,000 people. He is about 50 years old, six feet high, and of portly and dignified bearing, of a dark chocolate color, but with curved, aquiline nose, thin lips and a

strong and handsome profile. He is extremely wealthy, not only in flocks but in silver and gold, jewels and precious arms, fine horses and numerous slaves. He reads and writes Arabic, but knows no other language. The Khedive requires him to reside on the banks of the Nile; but he escorts us, with some of his retainers, on this expedition. He has with him ten or twelve dromedaries of his own and twice as many servants, and five or six large army tents for his accommodation. Whenever we come across encampments of his people on the deserts they come forward to do him reverence as their prince and sovereign. They kiss his hand and the hem of his garment, and submit their suits for his decision. He, seated under a tree or at his tent door, administers justice precisely as the ancient kings of Israel are described as doing; and let me tell you that no king or emperor could have a more dignified and commanding manner. His ancestors were rulers for centuries past. His father was the Sheikh Kralif. When the Memlooks were destroyed by Mohâmmed Ali in 1811, the small remnant that escaped the massacre fled to these deserts and Kralif gave them refuge and hospitality, and when the dreaded Ibrahim Pacha arrived in pursuit with his army, Kralif alone was bold enough to acknowledge what he had done and to vindicate his course. Soon after, he was murdered by a Turkish Governor, and was succeeded by his brother Baraca. The latter bided his time and retaliated, according to the custom of his race, by murdering the Turkish governor, and some years afterward he was assassinated by the Turk's relatives. Mohammed Khalifa, in his turn, took up the avenging of blood, and the vendetta did not cease until one or two of the Turks had been killed and the rest had fled the country. When, after eight months' travelling through the eastern desert, we reached the banks of the Nile, near Abou Hamed, Mahommed Kalifa gave a great feast at his residence to the entire expedition. Many sheep were slaughtered and fowl without number. We officers had our dinner apart—fifty and more dishes, served up in the Arab fashion, a sheep roasted whole being the great *pièce de resistance.* The line officers and soldiers, the camel men, the servants, all had theirs, seated in numerous groups of eight or ten, and waited upon by the Kalifa's slaves. He, with a dignity and grace of manner which any nobleman might envy, commencing with us, went from

group to group, breaking bread and eating just one mouthful with each, accompanying the act with some graceful oriental compliment. He reminded me of Abraham, only that he is a grander and more powerful sheikh than Abraham ever was, and you may be very certain that he would never have let Sarah force him to drive out Hagar and Ishmael to perish with hunger and thirst in the desert.

I have tried to make you familiar with the conditions of life and the transportation on the desert, and the people who roam over its surface. Let us now enter the strange and wonderful land.

The Arabs divide their deserts into two kinds. The first they call *el jebel*, or *el berriyeh*, *i. e.*, the mountain, or wilderness. This is diversified by wadies—the word *wady* (pronounced waddy) corresponding to valley, or watercourse. These are always found in mountainous regions like the Arabian chain, whose highest peaks rise to over 7,000 feet.

The mountains themselves are only naked rocks, always perfectly bare of all trees and vegetation. In fact, the Bedouin can hardly believe that in Europe and America are great mountains covered with luxuriant forests and green pastures, from which flow rivulets and cascades of perennial waters. This idea is as strange to them as the existence of ice. During the rainy season the waters run down the channels which they have hollowed out for themselves at the foot of the mountains, and these depressions are the wadies Some of them contain a great deal of vegetation—that is, a great deal for that country.

The other kind of desert is called the *atmour*. It is the superlative desert—the desert par excellence. It consists of plains of hard gravel diversified by zones of deep sands, rocky belts, and rugged defiles. It is absolutely and entirely destitute of *all* vegetation. Not a tree, not a bush, not a blade of grass relieves the eyes, which are painfully affected by the fierce reflection of the sunlight upon the yellow sand. No shade whatever is to be found unless it is cast by some great rock. These atmours, generally nine or ten days' journey across, are like oceans, which you may traverse on your four-footed ship, but where you may not tarry, and where caravans cross each other like vessels on the ocean.

Of course, the conditions of travel differ very much on the atmour from what they are in the wilderness, though after a long drouth

the latter is almost as terrible as the atmour. I will endeavor to picture to you life in these deserts as in two tableaux.

The first is the wilderness such as is spoken of in the Bible, where John the Baptist roamed, and multitudes went out to hear him. We will suppose that we are in mid-winter—the most delightful of seasons in that climate. On New Year's day we take one last glance at the ruins of the Greco-Roman city of Berenicé, and our last bath in the blue and limpid waves of the Red sea, the bluest sea that I ever saw. We are now traveling southwest to explore the deserts between us and the Nile, and especially the ancient gold mines of Derehib, worked by the Ptolemies more than 2,000 years ago, and again by the Arabs in the 9th century of our era.

The camels, refreshed by the abundant pasture, are in splendid condition. Our Bedouins are in fine spirits, for they know that pasturage and water will be found in plenty until we reach the great atmour of Shigré. During the month of November there were 17 days during which more or less rain fell—the first for three years past, so that all the wells and reservoirs are full. These rains bring out the vegetation in the wadies with magical rapidity. The trees, which had shed their leaves during the fierce heat of summer, are now clothed in green and fresh foliage, though the mountains remain as bare as ever.

The blast of the bugle sounds "forward;" but a couple of hours are always lost on the first day in adjusting and dividing the loads to each camel, and this allotment is the source of endless squabbles and cataracts of words, but nothing worse, among the camel-drivers. When 500 camels are being packed, all bellowing and roaring like lions, and 200 Arabs are yelling like demons at the same time, you might well imagine that Pandemonium had broken loose. At last all are loaded, and the burdens equally balanced by the Bedouins, who display wonderful skill in binding chests, boxes, tents and all other baggage with ropes made of bark fibres, and in fastening them by loops and pegs to the peaks of the wooden pack saddles. The bugle sounds again, and away the column gets in motion. We ride on for a mile and then we halt to let them defile before us, and to see that all is right. First come a couple of mounted Bedouin guides and several more on foot. Next artillery—a twelve-pound howitzer and a mitrailleuse being carried on the largest camels

that could be found, and which will have to be relieved more than once. The guns are dismounted from their carriages, which are carried on other camels, and are placed on huge pack saddles made for the purpose. The ammunition for the artillery and infantry, as well as a couple of rocket stands, follows close on, headed by the artillery officer and escorted by his men.

Next come the baggage and camp equipage and the water train, and each camel, beside his burden, carries a soldier or a servant. Where a defile in the mountains has to be crossed they go in single file; but where the wadies widen out and in the plains the caravan moves in several trails with a front of a hundred yards, and as they go on, the burden camels graze on the new spring herbage without slackening their gait of two and a half miles an hour. The sight is most picturesque. The column covers more ground than a full regiment of cavalry. There go the sheikhs in their white burnouses and turbans, pistols and yataghans in their belts, and their swords and muskets hung to the saddle pommels. The camel-drivers are on foot, bareheaded all, and generally barefooted, though some wear sandals. All of them carry swords or lances, or some other weapon. We observe one *beggar*, black as the ace of spades, whose costume consists solely of a couple of yards of white cotton wound round his loins, and in this belt he carries a pair of brass-mounted, flint-lock horse-pistols. Another fellow has but one sandal, and every hundred yards he shifts it from one foot to the other, nor will he throw it away as long as it hangs together.

The black skins of the Bedouins contrast beautifully with the snow-white uniforms of the soldiers and their red tarboushes, and the parti-colored costumes of the sheikhs and of our camp followers. The weather is lovely, and laughter and endless gabble are heard along the line, while quips and jokes explode like fire-crackers from one end of the column to the other. Last, but not least, comes old Gama—a Bedouin of seventy-five—driving along the flock of thirty or forty Soudan sheep, which wear hair instead of wool, that being the fashion for sheep in their country. They keep up easily with the caravan, and during the good season they fatten as they go. Every now and then during the first mile or two a camel which feels that his load is not equally balanced flops down and begins bellowing, nor will he rise again until it has been

adjusted, and in the meantime half-a-dozen of his neighbors will follow suit, and roar in unison to show their sympathy. At other times an exuberant camel starts to run and jump, and he goes bumping and thumping among the others, smashing a box or two, scattering pots and pans, camp-stools and blankets, to the irreparable damage of much crockery, which is not to be replaced. But in an hour or two everything will begin to work smoothly and steadily. The first day's march we rise 1,500 feet in a few hours, and from a rocky pass in the mountains we turn to take a last glance at the Red sea, with its blue waters and whitening coral reefs. It is the last expanse of water that we shall see until we reach the Nile. For days and days we keep on making only short marches, for we are in no haste. We have to map out the route, and water and pasture being abundant, we can stop anywhere we want. Sometimes we camp for several days in a pleasant wady, where a torrent flowed for a few hours after each rain in the season. Now, the dry bed of the water-course is marked by the desert vegetation. There are wild flowers of various kinds—among them acres of heliotrope, and a bush called *merk*, resembling the Scotch broom, bearing a small five-pointed yellow star of sweetest perfume; many species of herbaceous plants, containing so much water that neither camels nor sheep will need being watered for weeks to come; and along the sides of the wady, sometimes growing so regularly that they seem to be planted by the hand of man, are varieties of trees peculiar to the region. Among these, predominate two species of accacia mimosa—the *seyal*, which grows to considerable size, and the *sount*, whose bark is used for tanning and for making saddles and various utensils; the *heglik*, noted for its bitter fruit and smell as well as its dark green foliage. These and many others generally fringe the sides of the wady, but when the latter expands to a mile or so in breadth, then they dot the ground at irregular intervals, and when we ascend a neighboring height the valley looks so much like a cultivated country, with irregular orchards among the fields, that we almost look for the white cottages of the peasantry. But permanent dwellings in that land there are none; only our snow-white tents and the brown camel's hair tents of the Bedouins—here to-day and gone to-morrow.

Among the most picturesque and charming of these valleys was

Wady Hodeïn, which means valley of the two fountains, so called from two springs which issue from a lofty sandstone cliff. Such a thing as a *living* spring in the desert is almost miraculous. Even in Palestine, which contains no such deserts as those of Egypt, the frequent Scriptural expression "living waters" shows the value attached to them. The Ptolemies, who hunted with a train of 2,000 or 3,000 men in those regions 2,000 years ago, carved in the face of the cliff over the principal spring a cornice of Egyptian architecture, with the toron and globe found on all Egyptian temples. Near it is a cartouche, bearing the hieroglyphics of Ptolomy Evergetes. The water flows from the base of the cliff into a rocky basin, but it disappears within fifty yards into the sand. Not far from this was a fortified station for some 2,500 men, planned and constructed according to all the rules of Greek castrametation, with its regular lines and bastions, barracks for the soldiers, and a stronghold in the centre. There we found numerous fragments of Greek inscriptions upon the broken stones, proving that it was the hunting station mentioned by Strabo 1,900 years ago. And no wonder it was so, for all these wadies abound with grouse, capricorns, hares and wild asses. Gazelles and ostriches are less abundant, for they prefer the open plains. Nor while enumerating the fauna of that region must we omit some disagreeable specimens—the locusts, the serpents and the scorpions, which last are quite numerous and entirely too fond of resting in your blankets of a cold night; but they are very inoffensive if you only let them alone. Add to these the vultures, which walk familiarly around the camp to see what they can pick up, and the jackals and hyenas, whose howls can be heard in the night.

Traveling in the wadies of the Arabian chain at this season is really delightful. Frequently during a day's march, we cross from one wady to another through frowning and narrow defiles, between gates of gigantic granite and basaltic cliffs, assuming the wildest and most fantastic forms. We pass the great peak of Mt. Hegat, towering 2,000 feet above the wady, and looking like one solid block of polished granite, glistening in the sunlight. Then we come down again to a green wady and pitch camp. The nights are cold up here in January and February, though the thermometer never comes within many degrees of freezing point. Fatigue parties bring in with little trouble the abundant deadwood floated

down the torrent's bed during the last rainy season. Quickly, dozens of camp fires illuminate the valley. The large Soudan sheep, whose meat has become juicy and well flavored upon the aromatic herbages of the desert, affords us a delicious roast, added to the grouse and other game we have killed on the day's march. This, together with onions, beans and rice, the only vegetables we can transport, and hard crackers by way of bread, supplies us a very good bill of fare, and we have the best of sauces—a good appetite. To the dinner succeeds the fragrant and unequaled Arab coffee, straight from Mocha, then pipes and pleasant chat, while all around we hear the laughter and endless talk of the good-natured soldiers and Bedouins mingled with the sound of the viol, called *kemengheh*, accompanying the wild and barbaric songs of the Arabs. Occasionally of a moonlight night, the Ababdehs perform their national war dance with sword and shield in mock attack and defense, and even the princely Mohammed Khalifa, in his flowing robes, does not disdain to take a part in it, while the beating of the *darabuka* wakes up the echoes of the wady and the answering yells of the astonished jackals and hyenas.

Such was life in the Arabian chain, where I wandered for eight months and more, prospecting the country, and making reconnoissances on both sides of the route. I wish I had time to tell you about the ancient gold mines of Derehib, which I visited in the great Wady Allaki, worked by the Greeks under the Ptolemies more than 2,000 years ago, and again in the ninth century of our era by the Arabs, who exhausted them entirely. Abundant vestiges of their occupation are found in the shape of potteries, inscriptions and porphyry mills used to pulverize the quartz. The most important remains are two Arab castles, where the garrisons were kept and the gold and supplies were stored.

I have shown you the bright side of the desert. Now look on the other. It is now May, 1875. The sun has again crossed the line and is shining vertically over our heads. We are on the west of the Nile, on the desolate atmours which separate the river from the hardly less barren plains of Kordofan. A more parched, blasted and blighted country than it is at this period, cannot be conceived. It is the end of the dry season, and half of the rare wells are exhausted, and those which are not, furnish only a scanty supply of

brackish water at temperatures of 80° or more. The deeper the wells the warmer the water, for the central heat of the earth is very sensible at 150 and 200 feet. The marches are perfectly terrible, and yet it is worse to halt during the day than to keep moving; for under the tents the heat redoubles as in a hot-house, making it impossible to rest or sleep. Thus, we march from earliest dawn often till night, for we must make the distance between the wells before our water gives out. On the burning sand the sun beats down with a fierceness which cannot be described. The barrel of your gun, the stirrup of your saddle, blister your hand and your foot. The thermometer rises to 150° in the sun, and in spite of the protection of your white helmet, a heavy silk scarf over it and the umbrella you carry, your skin peels off in blisters and your brain almost boils in your skull. On such plains which, like the deserts of Korosko and Shigré are nine or ten days across, there is no animal life at all. Only the ostrich and hyena cross them swiftly by night, and the ever present vulture wings his ceaseless flight over them. No one can realize the combination of complete silence, solitude and infinite space, who has not been in those deserts. When night comes and the Bedouins are all asleep in their bivouacs, walk away from the camp in the unequaled moonlight of Africa, beyond the first ridge of sand or rock; around you stretches an immense sealike horizon. The sand gleams almost as white as snow in the moon's rays. Not a sound falls upon your ear, not the murmur of a breeze not the hum of the smallest insect, not the rustle of leaf or grass; silence, only silence as profound as death, unless it is broken by the distant howl of a prowling hyena. Thus we travel the weary days, longing for night to come, while the sun, our fierce enemy, not only drinks our blood, burns our flesh and blisters our tongues, but also dries up our girbehs, which, full at starting, are shriveled to half their size by evaporation before the end of the first day. No more jokes and laughter now along the column. The soldiers and servants, covering their heads with blankets and turbans, bring over all the hoods of their heavy cloth burnouses, leaving only a narrow aperture sufficient to see; but, strange to say, the Bedouins, "to the manner born," trudge along on foot, bare-headed and almost naked, without suffering as much as we do. The air that blows is literally like blasts from a furnace or a brick-kiln. Over the surface of the

plain it quivers visibly in the sun, like that which rises from a red hot stove; and now the mirage, seen on all plains, appears with redoubled vividness, as if in mockery of our sufferings. It distorts and magnifies every distant object. When we come to some portion of the plain dotted with low bushes less than a yard high, they are extravagantly magnified. We long for some slight shade for our noonday meal. We see some trees half a mile ahead and we hasten towards them; but as we approach they dwindle down to small bushes. But surely there are the trees a little further on, and we ride towards them, and on and on, with the same result, until experience teaches us that it is all a delusion, and we have at last to take our lunch under the shadow of our camels. On the plains, the herbage, if we find any, is so dry that it crumbles to dust under the camel's tread; and the few trees are utterly bare of all foliage, exhibiting the paradox of a wintry aspect under this intense heat.

Another effect of the mirage is the mockery of water which it presents to the eye. This phenomenon is of continual occurrence. Before you, spreads a lake of vast extent; the water appears about a mile off; the trees, bushes and rocks, on what seems to be its margin, are reflected in the fictitious water with an appearance of reality that makes you doubt your senses. The quivering of the heated air adds to the delusion by imitating the ripple of water. As you move on, so does the lake, keeping always the same distance from you. The rocks and hills beyond also present the same appearance that they frequently do at sea, seeming to be suspended a little above the horizon. The Arabs call the mirage *bahr es Shaïtan* (Satan's sea or water), and they believe that it is the work of the Djinns. There is a very credible tradition that about fifty years ago an infantry brigade of Fellahs from Lower Egypt, being sent across the desert of Korosko, ignorant of this phenomenon and maddened by thirst, massacred the guides, who strove to deter them from chasing this devil's lake, and, keeping up the vain pursuit, they soon became exhausted and perished to a man. The tale is probable, for men already parched with thirst, moving rapidly on foot in the hot sun, could not live over five or six hours on the desert.

Another curious delusion is produced. If you are a mile distant from the caravan, the camels and men become extravagantly tall; and, what is more singular, they seem to be wading through shallow

water, and as each one moves along, there is his reflection in the water moving along with him, so perfect that you can hardly disbelieve your eyes.

The route across the great atmour of Korosko, which is one of the principal avenues of trade, stretches nine days' hard march from the Nile at Korosko to the Nile at Abouhamed, cutting off the great bend of the river. There is only one well, called Moura, bitter—just half way—and none but camels and Bedouins can drink its water. Here the track is well marked, in spite of occasional shifting sands, by the bleaching skeletons of camels, which average forty to fifty to the mile. Where the slopes are unusually steep or the sand very deep, there are some three to four hundred to the mile; sometimes in piles of five or six, where they fell to rise no more, especially near the half way, for on the fourth or fifth day from the Nile the weakest or most overburdened camels begin to give out. You hear a sudden roar along the line; it is one of these poor animals that has sunk down and refuses to rise again. His load is taken off and distributed among the others. Perhaps, then, he will rise and follow on, and if he can keep on to the next water he may be saved, but most frequently he can't rise any more. If there is time, the Bedouins cut his throat, and hastily remove the best parts of his flesh for their eating; otherwise, they leave him to his fate. Before he is dead, often before the caravan have left him, the watchful vultures are around him, and, as soon as night comes, the hyenas will complete the task. The next day little will remain but his hide and bones, which quickly pulverize and disappear under the burning sun. The Bedouins, who utilize the bark of every tree, the fibres of every grass, and the skins of all animals, can make no use of the camel's hide and bones. The poor beast lives so nearly on nothing all his life, that after his death his remains soon dry up and blow away. What with the desert scavengers, its pure air and its fierce furnace heat, the smell of carrion is never perceived there, although dead animals are so numerous.

As you may well suppose, no fuel is to be found on these atmours, with the only exception of dried camel's dung scattered along the trail. Towards the end of the day's march you see the drivers and servants running ahead of each other, eagerly picking it up from

the track and collecting it in the end of the cotton band which forms their only garment.

The bivouacs on the atmour are as gloomy as the march. No fires, no music or dancing now. The men are weary and have not enough water to drink their fill, and their tongues are too dry to talk. There is no pasture, so the drivers, spreading their blankets on the sand, pour on them the scanty rations of beans or dourra for their camels, which, lying down on their bellies, five or six around each blanket, consume their slender meal with their usual slowness and gravity, without squabbling or fighting over it as horses would do. Very soon all except the guard, are seeking in slumber the strength needed for the next day's march. Neither men nor animals could endure this kind of travelling if it were of long continued duration.

When the route crosses one of these atmours, the Bedouins know that they must provide grain for their camels and water for themselves. But avarice and improvidence are their chief characteristics: although they know perfectly well that the camels will fall and die by the way for want of food, they will never provide a sufficiency for their abstemious animals, and thus they lose many on every trip—and it is the same thing as to water for themselves. The Arab, when urged to provide for the future, always has a ready reply, "Allah kerim" (God is great), but this apparently pious adage expresses only his indolent expectation that something will turn up. Thus, on our marches of five days from well to well, the drivers and guides were always out of water the fourth day, and they would come to me begging piteously for it, though it was fully understood from the beginning that they were to supply their own water. Of course I always sternly refused, for if I had yielded once, the next time, depending upon me, they would have taken only three days' water. Necessarily a guard had to be detailed day and night to keep the water from being stolen.

I have now endeavored to trace before your eyes a picture of desert life, but time fails me to present you with a narrative of my personal adventures in Africa, which will furnish topics for other lectures. I beg your forgiveness for having detained you so long, and yet I have been obliged to omit many points of interest. I could talk to you for an hour longer about the pearl fishermen of the Red sea, its corals, its strange fishes, about the crocodile, the

hippopotamus and that wonder of the vegetable world, the baobab, or Adamsonia, which I saw on the plains of Kordofan ; and of personal anecdotes and strange types of humanity there would be no end, but I must stop. I know not whether I have succeeded in describing life in the desert as vividly as I remember it. I will add only that, as long as my health lasted, it was a charming life, full of interest, excitement and novelty, and free from all the petty cares which so often embitter existence in the centres of civilization. I felt as free as the Bedouins, and truly monarch of all I surveyed, for I only had to command to be obeyed. True, it is not a life of ease, suited to milk-sops or "moony and molluscous men," but, after all, the hardships were not too great to be borne by a healthy man.

As to supplies, we always had abundance. It is true the desert fare is not equal to Delmonico's, but what of that? Eating is not the object of life ; I have dined in Paris and London, in Rome and Cairo, with princes and diplomats, on the best that the land could afford, and I have dined also in the desert, seated on the sand with a Bedouin sheikh, on a hard cracker and a raw onion, more precious than pine-apples are at home, and I felt equally satisfied afterwards, and probably much happier. The great drawback to African explorations is the strain upon the health. How many of the African travellers have never returned, and how few of those that did have come back unimpaired! Had I not been gifted with a strong constitution, uninjured by excesses, I would not have the honor of standing before you to-night—much battered and damaged, it is true, but yet alive—to tell you of my travels and to say, in conclusion, that, roam where you will, you can find no country on the earth which, take it altogether, equals our own America ; and, notwithstanding her youthful imperfections in some things, no man whose heart is in the right place can fail to feel proud of being able to say in a foreign land, not "I am a Northerner, or a Southerner, or from the East or West," but "I AM AN AMERICAN CITIZEN!"

MEETING AT CHICKERING HALL, NEW YORK,

TUESDAY, NOV. 18, 1879.

The Society met at 8 P. M., the President, Chief Justice CHARLES P. DALY, in the Chair.

The election for new Fellows added the names of the following gentlemen to the roll: Maurice Wirths, C. A. Barattoni, Professor Charles W. Shields, Cornelius R. Agnew, M.D., Edward Gebhard, John R. Fellows, R. A. Caldwell, M.D., Royal C. Vilas, Augustus H. Levy, Grant Squires, S. Nicholson Kane, A. O. Lambert, John Fahnestock, Captain F. B. Hamilton, U.S.A., George Wilcoxson, Francis Linde Stetson, Ferdinand P. Earl, Joseph R. Thompson, General Edmund S. Bowen, Robert J. Turnbull, John Bleecker Miller, James Montieth. General Horatio G. Wright, U.S.A., Chief of Engineers, Washington, D. C., was elected a corresponding member.

The Rev. Dr. Roswell D. Hitchcock offered a resolution, which was adopted, of regret at the death of the Rev. Joseph Parrish Thompson, D.D., LL.D., who had been a member of the Society since 1854.

The following resolution, offered by Mr. F. A. Stout and seconded by Dr. I. I. Hayes, was then adopted:

" *Whereas*, Mr. James Gordon Bennett, with unabated desire to assist in solving the remaining great geographical problems of the world, has despatched the steam yacht *Jeannette* upon a voyage of Arctic discovery through Behring's Straits; and

" *Whereas*, The high reputation of its officers for science and seamanship, coupled with the thorough and generous preparation and outfit of the vessel provided by Mr. Bennett, and the navy discipline of the crew, are as complete an assurance of success as can be afforded; therefore

" *Resolved*, That this Society congratulates its fellow and good friend, Mr. Bennett, upon the success of the expedition so far as

heard from, and renews the expression of its appreciation of his continued and liberal interest in geographical science.

"*Resolved*, That the President be requested to transmit this preamble and resolution to Mr. Bennett."

The President then introduced the Right Honorable Earl of Dunraven, who read a paper on "Moose and Cariboo Hunting in Colorado and Canada." The reading lasted one hour and a half, and was listened to with great attention by a large audience. Among the gentlemen seated on the stage and in the body of the hall were—Mr. Edwards Pierrepont, Herr Frederick von Bodenstedt, Mr. Francis A. Stout, Professor Theodore W. Dwight, Dr. I. I. Hayes, General Egbert L. Viele, Mr. Elial F. Hall, the Rev. N. Bjerring, Colonel T. Bailey Myers, Mr. Neville Moritz, Mr. W. H. Morrell, Mr. William Remsen, Mr. N. M. Beckwith, the Rev. Roderick Terry, Mr. Perry Belmont, Mr. M. Van Buren, Vicar-General Quinn and Judge Charles A. Peabody.

LORD DUNRAVEN'S ADDRESS.

It would appear that the American continent was originally of considerably larger dimensions than it is at present. It was probably found to be altogether too large for comfort or convenience, and it was reduced by the simple process of pressing or squeezing it together from the sides, an operation which caused it to crumple up towards the centre and produced that great, elevated, tumbled and tossed region generally and vaguely known as the Rocky Mountains. If this simple theory of the formation of a continent sounds somewhat infantile, you must remember that I am not a scientific man, and that it is not more unscientific than many other theories of creation. There is no such thing as a chain of Rocky Mountains. You all know very well that under that term are included various ranges and belts of mountains which embrace within their far-stretching arms, fertile valleys, arid deserts, sunny hill slopes clothed with valuable timber, parks full of pastoral beauty, basking beneath a sun that warms them into semi-tropical life, but that never melts the virgin snow that whitens the hoary heads of the mountains that forever look down upon those smiling scenes. Rich and extensive plains, tracts of inhabitable land almost large enough to be the cradle and

home of nations, are included within the Rocky Mountains. Among all the States and Territories that lie wholly or partially within the borders of this vast, upheaved region, there is none (as far as I am aware) more favored by nature and at the same time more accessible to man than Colorado. It is easily reached even from the great cities of the East ; its scenery is varied, beautiful, grand, and even magnificent. Crystal streams of pure, wholesome water rush down the hillsides, play at hide and seek in the woods and wander deviously through the parks. The climate is health-giving, unsurpassed (as I believe) anywhere—giving to the jaded spirit, the unstrung nerves and weakened body a stimulant, a tone and vigor so delightful that none can appreciate it except those who have had the good fortune to experience it themselves. The parks of Colorado constitute its special feature ; there is nothing on this continent resembling them in natural characteristics. They are not valleys ; they are too flat and too extensive for that. They cannot be called plains ; they are not flat enough, and plains are generally bare and denuded of trees, while the parks are rich in timber, with beautiful undulating surfaces broken up by hills, spurs from the patent range and isolated mountains. The term "park" is usually applied to ground more or less artificially made. They are very properly called parks, for they look—if it be not rank heresy to liken nature to art—as if ground naturally picturesque had been carefully laid out and planted with most consummate skill and taste. Some of them (as you know) are of great size, such as the North, Middle, South, and St. Louis parks ; others (and it is with them I am best acquainted) are small. It is not difficult, after several days' hard work hunting, to spend an idle day or two in such a scene, watching the face of nature, ever changing under cloud and sunshine, calm and tempest. The eye never aches at the sight of lovely scenery, nor does the soul sadden. It is the one thing that never palls, with which neither mind nor body is ever weary.

It was sport—I mean in the English sense, hunting—that led me first to visit Estes park. Some friends and I had gone to Denver at Christmas to pay our proper devotions to the good things of this earth at that festive season, and hearing rumors of much game at Estes park, we determined to go there. We left the nearest railway

station at daylight, and had a long and weary journey, though the distance is but thirty miles. It is easy work, is not work at all in fact, to get into the park nowadays. It was a very different affair at that time. There are two good stage roads now. There was no road then, only a rough track going straight up hill and down dale, and over rocks and through trees, and along nearly perpendicular slopes, with the glorious determination to go straight forward of an old Roman road, but without any of the engineering skill and labor expended upon the latter. It was a hard road to travel, covered with snow and slippery with ice, but, what by literally putting our shoulders to the wheel up hill, by chaining up the wheels down hill, and by holding up the wagon by ropes and main strength on precipitous hillsides, we got to our destination very late at night, with only one serious accident—the fracture of a bottle containing medical comforts. The road traverses the level plain for about fifteen miles and then enters a cañon flanked on either side by strange-shaped masses of bright red sandstone, outcropping from the surface, and in some places tilted nearly on end, follows along the bank of the St. Vrains river, teeming with trout, crosses that stream and then works its way, with many curves and twists, up through the foot hills, along grassy slopes, through pine forests, past quaint, fantastic-shaped masses of rock; crosses a little creek buried deep among aspens and poplars and, after plunging down two violent descents and mounting up again, enters a long valley rejoicing in the euphonious title of Muggins's gulch. I do not know who Muggins was—no doubt an honest citizen—but he should have changed his name before bestowing it on such a pretty spot. You ascend this valley at an easy gradient till you reach the summit, when suddenly a lovely view bursts upon you, and the park lies spread out at your feet. On the left the hillside rises steeply, crowned with a buttress of frowning rock. On the right a mountain of almost bare, solid rock, stands naked and savage. In front, beyond the park, the main range rears itself, rent in two great chasms, topped with snow, pierced by the gloomy, heavily-timbered depths of black cañon. On the extreme left and in the distance Long's peak towers above its fellows, and beneath you, in strange contrast, between the barren foot-hills through which you have passed and the stern grandeur of the range,

lies the park, undulating, grass-covered, dotted with trees, peaceful and quiet, with a silver thread of water curving and twining through its midst.

I well remember the commencement of civilization. I was sitting on the stoop of the log shanty one fine hot summer's evening, when to me appeared the strange apparition of an aged gentleman on a diminutive donkey. He was the first stranger I had ever seen in the park. After surveying me in silence for some moments, he observed :

"Say, is this a pretty good place to drink whiskey in ?"

I replied "Yes," naturally, for I have never heard of a spot that was not considered favorable for the consumption of whiskey, Maine not excepted.

"Well, have you any to sell ?" he continued.

"No," I replied, "got none."

After gazing at me in sad silence for some minutes, evidently puzzled at the idea of a man and a house but no whiskey, he went slowly on his way and I saw him no more.

On the morning that Sandie and I went out, it was not necessary to go far from home. We had not ridden long before we came to likely-looking ground, got off, unsaddled, and tethered our horses and started on foot, carefully scanning the ground for fresh sign. Soon we came upon it—quite fresh tracks of three or four deer. Then we had to decide upon the plan of operations in a long and whispered conversation, and finally having settled where the deer were likely to be and how to get at them, we made a long circuit, so as to be down wind of the game, and went to work. The ground I am thinking of is very rough. It slopes precipitously towards the river. Huge masses of rock lie littered about on a surface pierced by many perpendicular, jagged crags hundreds of feet high. Long ridges and spurs strike downwards from the sheer scarp that crowns the cañon of the river, forming beautiful little glades, sheltered, sunny, clothed with sweet grass, in which the deer love to feed. In such a country there was no chance of seeing game at any distance, so we had to go very cautiously, examining every sign, crawling up every little ridge, and inch by inch craning our heads over, and peering into every bush and under every tree. In

looking over a rise of ground it is advisable for the hunter to take off his head-covering, unless he wears a very close-fitting cap. I have often laughed to see great hunters—(great in their own estimation)—raising their heads most carefully, forgetting that a tall gray felt hat, some six inches above their eyes, had already been for some time in full view of the deer. Many hunters seem to think that the deer cannot see them until they see the deer. The hunter cannot go too slowly, and it is better to hunt out one little gully thoroughly than to cover miles of ground in the day.

When deep snow lies upon the higher ground wapiti come down into the park in considerable numbers. The wapiti is a splendid beast, the handsomest by far of all the deer tribe. He is called an elk in the States—why, I do not know, for the European elk is identical with the American moose, and a moose and a wapiti are not the least alike. But I presume the wapiti is called an elk for the same reason that thrushes are called robins and grouse partridges. The reason, I dare say, is a good one, but I do not know what it is. The wapiti enjoys a range extending from the Pacific seaboard to the Mississippi and from the Northwest Territory in British possessions down to Texas, and he formerly was found all the way across the continent and in the Eastern States. He is exactly like the European red deer, only about twice as large, carries magnificent antlers, and is altogether a glorious animal. Wapiti are to be met with in forests of timber, among the mountains and on the treeless prairie. They are, I think, most numerous on the plains, but the finest specimens are found in timbered districts. One might suppose that branching antlers would cause inconvenience to an animal running through the tangle of a primeval forest, but the contrary appears to be the case, for in all countries the woodland deer carry far finer heads than the stags of the same species that range in open country. Wapiti are very shy. They require quiet and large, undisturbed pastures, and they are hunted with a thoughtless brutality that must shortly lead to their extermination in civilized districts.

Speaking of mountain sheep reminds me of the first time I ever saw one. I should tell you first what a mountain sheep is. Ovis Montana is very closely allied, if he is not identical, with Ovis Argoli,

the wild sheep of Asia, and is akin to the moufflon of Europe. He stands about as high as a black-tailed deer, but is much thicker and more massively made in the body and limbs. His head resembles somewhat that of the domestic sheep, but is larger and more powerful looking, and the male carries a huge pair of curving horns. The females, also, have small horns. The hair is coarse, very thick and close, like that of the deer in texture, but bluer in color over the greater portion of his body, with the peculiar exception that he looks as if he was in the habit of sitting down in the snow and some stuck to him. He is a grand and noble looking animal, viewed standing motionless on some jetting crag, or bounding with gigantic springs down a precipice that apparently could not afford a foothold to any living thing.

Some years ago I doubted the existence of this animal. I classed him with gorgons, dragons and unicorns. I had read about him in books, but in all my wanderings I had never seen one, not even a stuffed specimen; neither had I come across any reliable man who had killed one. One day, while hunting on the plains, the government scout of a neighboring post told me he was certain that there were big-horns about Chimney rock, in Scott's bluffs. I did not believe him in the least, but as a large party of us, including some soldiers, were going through from a post on the railway to Fort Laramie, we determined to spend a few days on Scott's bluffs and prospect there for sheep. We started, and a very pleasant time we had, skirting the base of the hills, following the old emigrant track to Utah. The month was December, the weather fine and open, and game, that is deer and antelope, abundant, with an occasional buffalo for a change. One day I went out alone on foot to look for a deer. I had not gone very far, walking along a ridge, keeping a sharp lookout on either side, before I espied a long way off a party of five or six deer. Taking care to keep myself concealed, I got up within good view and took a spy at them with my field-glasses to see if there was a good head among the gang. There they were, one, two, three, four, five deer feeding quietly, but I could not make out any antlers among them. "Curious looking deer, too," I thought to myself, and screwed the glasses in a little and steadied myself for a better look. "Well," I thought, "there is surely some-

thing strange about them, something odd about the color, something unusual in the shape." Of a sudden a thought that felt red-hot rushed through me—what if they should be sheep? "By Jove, they are sheep!" I exclaimed, as one moved a little into a better light; "two big rams. Just look at their horns—and three small ones. Then there really are sheep, and I have found them." I declare I felt as excited as if I had discovered a new animal or attained to the north pole. I was so nervous I could not do anything for some minutes, but after a while set to work in fear and trembling to execute a scientific stalk. I was doomed to awful disappointment that day. Two others of the party were out shooting coyotes, birds, anything they came across, and when, after infinite trouble, I had crept up within shooting distance, they fired a shot and started the sheep, and I had all my labor to begin over again. To make a long story short, I made three stalks on those sheep and three times the same thing happened. The third time they were seriously scared and ran so far that, as it was getting late, I was obliged to leave them, and with a very heavy heart set a gloomy face towards home. On my way over a high ridge I noticed something curious away out on the plains, near a bend of the Platte, and with the glasses made out a lot of tents or Indian lepees, I could not determine which. We had a consultation about it in camp that evening and decided that, as there were no Indians in the neighborhood, what I saw must have been the tents of a company of soldiers which were expected to meet us from Laramie. The next morning my hunting companion, Sandie, and I started off to take up the trail of the sheep. We galloped along till opposite the place where I had last seen them, picketed our horses and commenced climbing the hills. We had not gone twenty yards when I saw something moving in the far distance. Out with the glasses. "Perhaps it's one of the sheep," I thought. "Hello!" I cried, amid general consternation; "it's a man." Another good look. "No, it's a woman. No, a man in a blanket—an Indian."

Without another word, down we went as flat as serpents in the grass, crawled back to our horses, and then helter-skelter back to the camp as hard as we could go. We found camp in a bustle—men with their carbines in their hands saddling up, tents being taken

down, and a lot of ugly looking savages sitting about three or four hundred yards off, on a rock, with their blankets drawn up to their noses, looking on, while several more noble red-skins were hovering about. It did not look pleasant. More and more Indians kept arriving, and after awhile, getting bold, some of them came in making friendly signs, shook hands and sat down and smoked with us. They informed us that "heap of Sioux coming; heap wagon. White man with them." They professed great friendship, but were very saucy and tried to steal everything they could lay their hands on; so we concluded to clear out, struck tents, bundled everything into the wagons, and left with, as far as I am concerned, no amiable feelings towards the "cut-off" band of Sioux. I am generally rather partial to Indians, but they had no right to spoil my hunting and destroy my chance of getting a sheep. Late in the evening, after dark, we arrived at a little solitary cattle-ranch, tenanted by one man. He was standing at the door, looking very uneasy and peering through the darkness, but he brightened up considerably when he saw we were white men. He was very hospitable. "Walk in, boys," he said; "walk right in and sit down. We ain't much heeled for chairs, I guess, but you must make yourselves as comfortable as you can." And so we sat down and had a long talk with him about Indians, and the lonely, dangerous life he led, and the difficulties of feeding cattle in Wyoming. That was the first sheep I ever saw, and the last for some time.

Towards August or September, any man who has once been in the woods will begin to feel stirring within him a restless craving for the forest—an intense desire to escape from civilization, a yearning to kick off his boots, and with them all the restraints, social and material, of ordinary life; and to revel once again in the luxury of moccasins, loose garments, absolute freedom of mind and body, and a complete escape from all the petty moral bondages and physical bandages of society. To a man who has once tasted of the woods, the instinct to return thither is as strong as that of the salmon to seek the sea. Let us, then, go into the woods. I will ask permission to skip all preliminary traveling, and consider that we have arrived at the last house, where Indians and canoes are waiting for us. Old John Williams, the Indian, beaming with

smiles, shakes hands and says: "My soul and body, sir, I am glad to see you back again in New Brunswick. How have you been, sir? Pretty smart, I hope." "Oh, first-rate, thank you, John; and how are you, and how did you get through the winter, and how is the farm getting on?" "Pretty well, sir. I killed a fine fat cow moose last December, that kept me in meat most all winter; farm is getting on splendid. I was just cutting my oats when I got your telegram, and dropped the scythe right there in the swarth, and left. I hear there's a sight of folks going in the woods this fall; more callers than moose, I guess." And so, after a little conversation with the other Indians, in the course of which we discover that, though they have been there three days, they have never thought of patching up the canoes, and have left the baking-powder or frying-pan or some equally essential article behind, we enter the settler's house, and so to supper and bed.

The first day is not pleasant. The canoes have to be carted ten miles to the head of the stream we propose descending, and the hay wagon wants mending, or the oxen have gone astray. Patience and perseverance, however, overcome all these and similar difficulties, and at last we are deposited on the margin of a tiny stream; the settler starts his patient, stolid oxen over the scarcely perceptible track, saying: "Well, good-day, gents; I hope you will make out all right," and we are left alone in the forest.

The first thing to be done is to make a little fire, and then with a hot brand melt the gum on the seams of the canoes where it may have been cracked by the jolting of the wagon, and to patch up with resin and pieces of calico, brought for the purpose, any holes in the bark. An Indian ascertains that his canoe is watertight by the simple method of applying his lips to every seam that appears leaky, and seeing whether the air sucks through. This ceremony he religiously performs every morning before launching his canoe, and every evening when he takes her out of the water. It looks as though he were embracing her with much affection, and it sounds like it; but in reality it must be an osculatory process more useful than agreeable, for a canoe, like an Indian squaw, though excellent for carrying burdens, cannot be particularly pleasant to kiss. Our canoes having successfully passed through this ordeal, they are care-

fully placed upon the water, brush is cut and laid along the bottom, the baggage carefully stowed, and away we start at last, three canoes, with a white man in the bow and a red man in the stern of each. Civilization, with all its worries, anxieties, disappointments, heat, dust, restraint, luxury and discomfort, are left behind; before us are the grand old woods, the open barrens, stream, lake and river, perfect freedom, lovely cool autumnal weather, three weeks' provisions, plenty of ammunition, the forest and the stream to supply food, and the fishing-rod and rifle with which to procure it.

Down we go, very slowly and carefully, wading half the time, lifting stones out of the way, tenderly lifting the canoes over shallows, for the stream scarcely trickles over its pebbly bed. After awhile the water deepens and becomes still. We take to the paddles and make rapid progress.

"Guess there's a dam pretty handy," says John, and so it turns out to be, for after a mile of dead water we are brought up by a beaver-dam, showing an almost dry river-bed below it. Canoes are drawn up and the dam is demolished in a few minutes, giving a couple of nights' hard labor to the industrious families whose houses we had passed a little way above the dam. Then we have to wait for half an hour to give the water a start of us, and then off again, poling, wading, paddling down the stream, until the sinking sun indicates time to camp.

In a few minutes—for all hands are used to the work—canoes are unladen, two tents pitched, soft beds of fir-tops spread evenly within them, wood cut and bright fires burning, more for cheerfulness than warmth. A box of hard bread is opened, tea brewed, and a ham set frizzing in the pan. Tea is a great thing in the woods. Indians are very fond of it; their plan is to put as much tea as they can get hold of into a kettle, and boil it until it is nearly strong enough to stand a spoon upright in. Of this bitter decoction they drink enormous quantities for supper, and immediately fall fast asleep, having nothing about them that answers to civilized nerves.

Sunrise finds us up; breakfast is soon over, tents are struck, canoes loaded, and we are on our way down the deepening stream. It is a river now, with lots of trout in the shallows, and salmon in the deep

pools. About noon we turn sharp off to the eastward up a little brawling brook, forcing our way with some difficulty up its shallow rapids till it gets too dry, and we are compelled to go ashore and to "carry" over to the lake whither we are bound. One of us stops behind to make a fire, boil the kettle and prepare the dinner, while the Indians swing each a canoe on to his shoulders and start through the woods. In three trips everything is carried across, and we embark again upon a lovely lake.

The "carry" was not long, only about half a mile, and there was a good blazed trail, so that it was a comparatively easy job ; but under the most favorable circumstances this *portaging*, or *carrying*, is very hard work. It is hard enough to have to lift eighty or one hundred pounds on your back. It is worse when you have to carry the burden half a mile, and get back as quickly as you can for another load ; and when you have to crawl under fallen limbs, climb over prostrate logs, balance yourself on slippery tree trunks, flounder through bogs, get tangled up in alder swamps, force yourself through branches which slap you viciously in the face, with a big load on your back, a hot sun overhead, and several mosquitoes on your nose, I know of nothing more calculated to cause an eruption of bad language, a considerable gain in animal heat, and a corresponding loss of temper. But it has to be done, and the best way is to take it coolly, and, if you cannot do that, to take it as coolly as you can.

Out on the lake it was blowing a gale, and right against us. We had to kneel in the bottom of the canoes, instead of sitting on the thwarts, and vigorously ply our paddles. The heavily laden craft plunged into the waves, shipping water at every jump, and sending the spray flying into our faces. Sometimes we would make good way, and then, in a squall, we would not gain an inch, and be almost driven on shore ; but after much labor we gained the shelter of a projecting point, and late in the evening reached our destination and drew up our canoes for the last time.

While others make camp, old John wanders off with head stooped and eyes fixed on the ground, according to his custom. The old man always looks as if he had lost something and was searching for it. Indeed, this is very often the case. I remember, after watching him one day prying and wandering about an old lumber camp, asking

him what on earth he was doing. "Oh, nothing, sir," he answered; "I hid a clay pipe here, somewhere—let me see, about thirty-five years ago—and I was looking for it." After dark he comes quietly in, sits down by the fire and lights his pipe, and, after smoking a little while, observes: "Moose been here, sir, not long ago. I saw fresh tracks, a cow and a calf close handy, just around that little point of woods." Another silence, and then he looks up with a smile of the most indescribable cunning and satisfaction, and adds: "I think, mebbe, get a moose pretty soon if we have a fine night." "Well, I hope so, John," say I. "Yes, sir, I see where he rub his horn, sir; you know the little meadow just across the hard wood ridge? why, where we saw the big cariboo tract three years ago. He's been fighting the bushes there. My soul and body, a big bull, sir, great works, tracks seven inches long." And so we fall to talking about former hunting excursions till bed-time, or rather sleepy time, comes, and we curl up in our blankets, full of hopes for the future, which may or may not be disappointed.

Moose calling commences about the 1st of September, and ends about the 15th of October. A full moon occurring between the middle and end of September is the best of all times. The best plan in calling is to fix upon a permanent camp and make little expeditions of two or three days' duration from it, returning to rest and get fresh supplies. Then you enjoy the true luxury of hunting. Then you feel really and thoroughly independent and free. The Indian carries your blanket, your coat, a little tea, sugar and bread, a kettle and two tin pannikins. The hunter has enough to do to carry himself, his rifle, ammunition, a small axe, hunting knife and a pair of field-glasses. Thus accoutred, clad in a flannel shirt and homespun continuations, moose-hide moccasins on your feet, your trousers tucked into woollen socks, your arms unencumbered with that useless article a coat, you plunge into the woods, the sun your guide in clear weather, your pocket-compass if it is cloudy, the beasts and birds and fishes your companions, and wander through the woods at will, sleeping where the fancy seizes you, "calling" if the nights are still or still-hunting on a windy day. Calling is the most fascinating, disappointing, exciting of all sports. You may be lucky at once and kill your moose the first night you go out, per-

haps at the very first call you make. You may be weeks and weeks, perhaps the whole calling season, without getting a shot. Moose-calling is simple enough in theory; in practice it is immensely difficult of application. It consists in imitating with a hollow cone made of birch bark the cry of the animal, thereby calling up a moose and shooting him by moonlight or in the early morning. He will come straight up to you within a few yards—walk right over you almost—answering, speaking, as the Indians term it, as he comes along, if nothing happens to scare him; but that is a great *if*, so many unavoidable accidents occur. The great advantage of moose-calling is that it takes one out in the woods during the most beautiful period of the whole year, when nature, tired with the labor of spring and summer, puts on her holiday garments and rests luxuriously before falling into the deep sleep of winter. The great heats are passed, though the days are still warm and sunny; the nights are calm and peaceful, the mornings cool, the evenings so rich in coloring that they seem to dye the whole woodland with sunset hues, for the maple, oak, birch and beech trees glow with the gorgeous autumnal tints which you all know so well. If the day is windy, you can track the moose and cariboo, or perchance a bear, through the deep, shady recesses of the forest. On a still day you may steal noiselessly over the smooth surface of some lake or quiet reach of still river water, fringed with alder, winding tortuously through natural meadows, or beneath a ridge crowned with birch and maples, whose feathery branches and crimson leaves are so clearly reflected on a surface perfectly placid that you seem to be gliding over a forest of submerged trees. Or you may indulge to perfection in that most luxurious pastime—doing nothing. I know a lovely place for that, on a hunting ground I used to frequent—a little island of woods about a quarter of a mile from camp, with a tall pine tree in the middle, which was kind enough to arrange its branches in such a way that it was very easy to climb. Thither I would go on lazy days, when I was tired with hunting, with my gun and a book, and leaning against its friendly trunk, read till I was tired of literature, and then climb up in the breezy branches and look out far and wide over the barrens on either side. Many a cariboo have I seen from there, and shot after an exciting stalk out on the plain.

A typical calling place would be a dry patch of ground, well sheltered with trees, surrounded by a small open space, a dryish barren, not too bare, but sparsely covered with stunted pines. Let us imagine ourselves to burst out of the thick woods, hot and tired, and to arrive at such a scene about four o'clock on a fine October day. Before us lies a still, deep reach of a little river, fringed on this side with brown alders. On the opposite side lies a piled-up, ragged heap of loose, gray granite blocks, with one solitary dead pine tree, stretching out its gaunt, bare, shrivelled limbs against the clear sky. Just beyond is a little clump of pines, and all around a gray meadow, quite open for some fifty yards or so, then dotted with occasional unhappy-looking pines, sad and forlorn, with long tresses of gray moss hanging from their stunted limbs. The trees grow closer and closer together, and become more vigorous in growth till they merge into the unbroken forest beyond. If I formed one of the party I would immediately take measures to make myself comfortable for the night, for I am of a luxurious habit. I would set one Indian, say John Williams, to look for water, which he would find by scooping a hole in the moss with his hands, into which cavity a black and muddy liquid would presently flow, not inviting to look at, but in an hour's time it will have settled clear enough to drink—in the dark. And I and the other Indian, say, Noel Glade, would turn to and make camp. That is easily done when you know how—so is making a watch. You clear away a space beneath some tree, making it nice and level, and set up a shelter on whichever side you apprehend the wind will come from. You stick some poles or young fir trees into the ground, prop them up with other trees, lash a pole horizontally along them with a bit of string, if you have one, or the flexible root of a fir if you have not, cut down a lot of pine branches and thatch the framework with them, till you have formed a little "lean-to" that will keep off a good deal of wind and all the dew. Then you strew the ground thickly with fir tops or bracken, gather a lot of dry wood, in case you want to make a fire, and all is ready for the night.

In a scene very like that I spent the last two nights of the calling season, not a hundred years ago. It was nearly sundown before our work was over, and leaving Noel to finish camp, I sent John to

a tree-top to look out, and sat down myself on a rock at a little distance to smoke the calumet of peace. These barrens are very melancholy at the decline of day, intensely sad, yet in their own way beautiful—full of delicate coloring. The gray, dead, tufted grass lies matted by the margin of the stream, over which brown alders droop, looking at their own images in the water, perfectly still save when some otter, beaver or muskrat plunges sullenly in and disturbs it for a moment. The ground, carpeted with cariboo moss, white as ivory but with purple roots, is smooth, save for a few detached, rugged masses of granite covered with gray or black lichens. An occasional dwarfed pine, encumbered with hanging festoons of moss, strives to grow in the wet soil, and on dryer spots two or three tall, naked, dead firs, that have been burned in some bygone fire, look pale like ghosts of trees in the deepening twilight. Beyond all, the forest rises, gloomy, black, mysterious. Nature looks sad, worn-out, dying, as though lamenting the ancient days and the inevitable approach of the white man's axe. Well in harmony with its melancholy mood are the birds and beasts that roam those solitudes and haunt the woods and streams—the hooting-owl, the loon that startles the night with its unearthly scream, are weird, uncanny creatures. The cariboo or reindeer, which was contemporary with many extinct animals of this globe—mammoths, cave bears and others—and which has seen strange sights among aboriginal men, has a strange look, as if belonging to some other world and some other time, with his fantastic antlers and great white mane, and so, too, has the huge ungainly moose that shares with him the forest and the swamp.

I had not, however, much time to indulge in reverie, for scarcely had I sat down before I heard old John call gently like a moose to attract my attention. Now, it must be borne in mind that when hunting you never call to any one like a human being—that might scare game—but you grunt like a moose, or, if you prefer it, hoot like an owl, or make any other sound emitted by the brute creation. I ran up and, in obedience to John's whisper, gave him the moose caller, and, following the direction of his eyes, saw a small bull moose slowly crossing the barren, some four or five hundred yards to our left. At the first sound from John's lips the moose stopped dead

short and looked around, then moved a few steps towards us and stopped again. We watched him for some time. He was evidently timid, and it seemed doubtful whether he would come up; and it was growing dark. Noel and I started to try and steal around the edge of the wood in order to cut him off before he could get into the timber and cross our tracks. We had not gone a hundred yards before we heard another bull coming up from a different direction through the forest, answering John's call. We could tell by the sound that he was a large one, and that he was coming up rapidly. The small bull heard him also and stopped. We were now, of a truth, in a dilemma. There was a moose in sight of us, but it was ten to one that he would smell our tracks and get scared before we could reach him. There was a larger moose coming through the woods, but where he would emerge it was impossible to say; and to make matters worse, it was rapidly getting dark. The difficulty was soon settled, for the smaller moose moved on again towards the woods, crossed our track, snuffed us, and started off across the barren at a trot; so we had to turn our attention to the larger one. He came on boldly; we could hear him call two or three times in succession, and then stop dead silent for a few minutes to listen, and then on again, speaking. We planted ourselves right in his way, just on the edge of the woods, and, crouching close to the ground, waited for him. Presently we heard his hoarse voice close to us, and the crackling of the bushes as he passed through them; then silence fell again, and we heard nothing but the thumping of our hearts; another advance, and he stopped once more, within apparently about fifty yards of us. After a long, almost insupportable pause, he came on again; we could hear his footsteps, we could hear the grass rustling, we could hear him breathing, we could see the bushes shaking, but we could not make out even the faintest outline of him in the dark. Again he stopped, and our hearts seemed to stand still also with expectation; another step must have brought him out almost within reach of me, when suddenly there was a tremendous crash. He had smelt us, and was off with a cracking of dead limbs, rattling of horns and smashing of branches, which made the woods resound again. Disappointed we were, but not unhappy, for the first duty of the hunter is to drill himself into

that peculiar frame of mind which enables a man to exult when he is successful, and to accept ill-luck and defeat without giving way to despondency.

It was by this time pitch dark, and there was no use, therefore, in calling any more. So in a few minutes we were seated round a bright cheerful little fire; the kettle was boiled, and we consoled ourselves with what story books call a "frugal meal" of bread and tea; and then reclining on our beds of bracken, with our backs to the fire, smoked, and chatted till sleep began to weigh our eyelids down. I have observed that in most accounts of travel and hunting adventure people are represented as lying with their feet to the fire. This is a great blunder. Always keep your shoulders and back warm, and you will be warm all over. If there are a number of people around one fine, and it is necessary to lie stretched out like the spokes of a wheel, the fire representing the axle, it is advisable, no doubt, to lie with your head outwards, for it is better to toast your heels than roast your head; but if there is room to lie lengthwise, always do so, and keep your back to the fire. Of course we talked about the moose we had so nearly killed. "My soul and body, sir," says John, "never see such luck in all my life; most as bad as we had two years ago when we was camped down east by the head of Martin's river. You remember, sir, the night we saw the little fire in the woods close by, when there was no one there to make it. Very curious that was; can't make that out at all. What was it, do you think?"

"Well, John," I said, "I suppose it must have been a piece of dead wood shining."

"Yes, sir; but it did not look like that; most too red and flickering for dead wood."

"Perhaps ghosts making a fire, John," said I.

"Yes, sir, mebbe; some of our people believe in ghosts, sir; very foolish people, some Indians."

"Don't you, John?"

"Oh, no, sir; I never seed no ghosts. I have seen and heard some curious things, though. I was hunting once with two gentlemen near Rocky river—you know the place well, sir. We were all sitting in the camp; winter time, sir; pretty late, about bed-time.

The gentlemen were drinking their grog, and we was smoking and talking, when we heard some one walking, coming up to the camp. 'Holloa!' says one of the gentlemen, 'who can this be at this time of night?' Well, sir, we stopped talking, and we all heard the man walk up to the door, but did not open it, did not speak, did not knock. So, after a little, one of us looked out—nobody there; nobody there at all, sir. Next morning there was not a track on the snow—not a track—and no snow fell in the night. Well, sir, we stayed there a fortnight, and most every night we would hear a man in moccasins walk up to the door and stop; and if we looked, there was no one there and he left no track in the snow. What was it, do you think, sir?"

"I don't know, John, I'm sure," I said, "unless it was some strange effect of wind in the trees."

"Well, I seed a curious thing once. I was hunting with a gentleman—from old country, I think he was—my word, sir, a long time ago, mebbe thirty years or more; my soul and body, sir, what a sight of moose there was in the woods in those days! and the cariboo run in great herds then; all failing now, sir, all failing. We were following cariboo, right fresh tracks in the snow; we were keeping a sharp lookout, expecting to view them every minute, when I looked up and saw a man standing right between us and where the cariboo had gone. He was not more than two hundred yards off—I could see him quite plain. He had on a cloth cap and a green blanket-coat with a belt round the middle—not a leather belt like we use, sir, but a woolen one like what the Frenchmen uses in Canada. There was braid down the seams of his coat and round the cuffs. I could see the braid quite plain. He had no gun, nor ax, nor nothing in his hands, but just stood there with his hand on his hip, that way, right in the path, doing nothing. 'Our hunting all over, sir,' I said to the gentleman; 'we may as well go home.' 'Why, what is the matter, John?' says he. 'Why, look at the man there right in the track; he's scared our cariboo, I guess.' Well, sir, he was very mad, the gentleman was, and was for turning right round and going home; but I wanted to go up and speak to the man. He stood there all the time—never moved. I kind of bowed, nodded my head to him, and he kind of nodded his head, bowed just the

same way to me. Well, I started to go up to him, when up rose a great fat cow-moose between him and me. 'Look at the moose, Captain,' I said. 'Shoot her !' 'Good heavens ! John,' he says, 'if I do, I shall shoot the man too !' 'No, no, sir, never mind,' I cried, 'fire at the moose.' Well, sir, he up with the gun, fired, and downed the moose. She just ran a few yards, pitched forward, and fell dead. When the smoke cleared off, the man was gone ; could not see him nowheres. 'My soul and body ! what's become of the man, Captain ?' I says. 'Dunno, John ; perhaps he's down, too,' says he. 'Well, sir,' says I, 'you stop here, and I will go and look ; mebbe he is dead, mebbe not quite dead yet.' Well, I went up to the place, and there was nothing there—nothing but a little pine tree, no man at all. I went all round, sir—no tracks, no sign of a man anywhere on the snow. What was it, do you think, sir, we saw ?"

"Well, John," I replied, "I think that was a curious instance of refraction." "Oh, mebbe," says John ; "guess I will take a little nap, now—moon get up by and by ;" and in another instant he was fast asleep. Indians have a wonderful faculty for going to sleep. They seem to shut themselves up at will, with a snap like slamming down the lid of a box with a spring, and are fast asleep in a second; and there they will lie, snoring and shivering with cold until you touch or call them, and then they are wide awake in an instant, as if they pressed some knob concealed in their internal mechanism, and flew suddenly open again.

I remember seeing a curious instance of refraction once myself. We were paddling home one evening, old John and I, along a still deep reach of dead water, gliding dreamily over a surface literally as smooth as a polished mirror. It was evening, and the sun was only just clear of the tree tops on the western side. Happening to look up, I saw on the eastern side a shadow, a stooping form, glide across the trees about twenty or thirty feet from the ground and disappear. It looked very ghost-like, and for an instant it startled me. In a few seconds it reappeared, and, the trees growing thicker together, and affording a better background, I saw the shadows plainly—two figures in a canoe gliding along in the air, the shadows of John and myself, cast up at an obtuse angle from the surface of the water by the almost level rays of the setting sun.

The Indians soon were comfortably sleeping, and had wandered off into the land of dreams; but I, my nature being vitiated by many years of civilization, could not so easily yield to the wooing of the drowsy god. For some time I lay awake, blinking lazily at the fire, watching flickering forms and fading faces in the glowing embers, speculating idly on the fortunes of the red Indian race, and on the destinies of the vast continent around me—in memory revisiting many lovely scenes, and going over again in thought the hunting adventures and canoeing voyages of former days. The palmy days of canoeing are past and gone. Time was when fleets of large birch-bark canoes, capable of carrying some tons weight, navigated the waters of the St. Lawrence, of the Ottawa, and of the great lakes to the mouths of different rivers on the north shore of Lake Superior, where they are met by smaller canoes arriving from the shores of the frozen ocean, from unnamed lakes and unknown rivers, from unexplored regions, from countries inhabited by wild animals and fur-bearing beasts—districts as large as European countries lying unnoticed in the vast territories of British North America.

All this is changed, though a great trade is still carried on by meams of these primitive but most useful and graceful boats. Steamers ply upon the lakes and ascend the rivers, the country is being rapidly opened up, wrested from wild nature, and turned into a habitation fit for civilized man. One of the pleasantest canoe voyages I ever made was from Fort William, at the mouth of the Kaministiquoya, to Fort Garry, situated close to the junction of the Assineboin with the Red river of the north, and near to the shores of Lake Winnipeg. That was but a few years ago; but how all that country has changed since then! Winnipeg was a very small place then, scarcely known to the outside world. I remember I met a family in the steamer on Lake Superior, a lady and gentleman and their children, and when in the course of the conversation it came out that they were going to Winnipeg, I felt almost as much astonished as if they had told me they were on their way to spend the summer at their country residence at the north pole. Now Winnipeg has become a flourishing town. The trading post of Fort Garry is submerged and overwhelmed by a mass

of civilization; Manitoba is a province, and a growing and prosperous one. One of the finest, if not the very finest, agricultural districts in the world has been opened up to man. It is a district capable of producing the choicest wheat in practically limitless quantities. It is blessed with many advantages, but it also labors under certain disadvantages which must not be overlooked. Three great rivers flow into Lake Winnipeg—the Red river, the Saskatchewan and the Winnipeg. The latter river is magnificent so far as scenery is concerned, but it is full of dangerous rapids, and will never be of any great commercial value to the country. The Red river is navigable for steamers for a distance of 600 miles. 185 miles only of its course lie in British territory; the remainder of the distance it traverses the State of Minnesota. The land it drains is rich alluvial prairie. At a distance of 40 miles from its mouth it receives the waters of the Assineboin, a river flowing entirely through British territory; it is said to be navigable for 300 miles. The two Saskatchewans rise in the Rocky mountains about 30 miles apart and pursue slightly diverging courses, till they become separated by a distance of nearly 300 miles. They then gradually converge again until they join together at a distance of about 800 miles from their headwaters, and then, after a united course of nearly 300 miles, discharge their mingled waters into Lake Winnipeg. With the exception of the last few miles of their course, these rivers are navigable for steamers, the one—that is, the North Saskatchewan—for 1,000, and the South branch for 800 miles. Between them, and on each side of them, lies the fertile belt, a virgin soil of any depth. No forests encumber the land. The farmer has but to turn up the soil, lying ready waiting for the seed. It is a mistake to suppose that all this great Western country is good land; that is nonsense. There is good and there is bad; but it is true that there is little bad and much good. Hundreds and hundreds of thousands of acres of the best land in the world are lying there idle, waiting for man. From the southern boundary of the United States to the South Saskatchewan, there is no such fertile tract as this. It is like a huge oasis lying between the parched pasture of the south and the frozen solitudes of the icy north. Nor is the wheat-growing country confined to the great

tract that drains into Lake Winnipeg. If the reader will look at the isothermal line upon a map, he will find that it takes a tremendous sweep northward a little to the west of the center of the continent, and includes the great Peace river valley, a portion of the Athabaska district and of the valley of the Mackenzie river. The day will come when wheat will be grown in that country within a very few degrees of the Arctic Circle. Nature has been bountiful to these northwestern provinces. The warm breezes from the west waft them prosperity, but it is their northern positions which proves the only drawback to them. The chief difficulty is a difficulty of communication. The value of land in a country where land is plentiful and cheap, depends upon the cost of transporting the produce of the soil to market. The great wheat producing region I have described is at present tapped by a line of railway running south through the United States. That cannot be called a natural, or altogether a proper outlet. It is not worth while anticipating any serious difficulty between the United States and the British empire. We may for practical purposes dismiss that contingency from our calculations, as one most unlikely to occur. It is becoming more and more improbable every year, as the two nations learn to understand and appreciate each other better. But, at the same time, it is highly inexpedient that the produce of any portion of the British empire should, in seeking its natural market in other portions of the same empire, be compelled to pass through the territories of another nation. When that produce consists of the first necessary of life, the inexpediency is increased.

There is another line of railway in course of construction which will carry grain from Manitoba to the north shore of Lake Superior, whence it can be transported by ships or barges over the broad waters of the great lakes and down the majestic current of the St. Lawrence to the ocean. But on this line also there is a difficulty, an obstruction. The waters of that inland sea, Lake Superior, pour themselves into Lake Huron in a boiling, tumultuous flood, down the rapid known as the Sault St. Mary. This rapid is quite impassible, and ships go round it through a canal which is in the State of Michigan. This is a disadvantage to the route, but not a very great one, for the canal is only a few miles in length. A convention,

I believe, exists between the Canadian and United States governments regulating the rates to be charged upon it, and, moreover, there is no engineering difficulty whatever in constructing a canal on the British side of the river. It is true that the canal is closed by ice during the winter months, but free navigation exists during the greater part of the year, and the St. Lawrence is also closed during the winter. Any one looking at a map of British North America will say at once, "But neither of these routes is the national geographical road in and out of this country. The Hudson Bay Company long ago discovered and made use of the proper outlet, and the grain of thousands and thousands of fertile acres will find its way to London by the same means and over the same roads as the skins of wild animals have been brought to that market." I wish I could think that was true. Then indeed would Manitoba and the great Northwest be the most favored country in the world—the earthly paradise of the agriculturist.

Hudson's bay and the river flowing into it from Lake Winnipeg form the natural gateway to the great Northwest, and Lake Winnipeg is the natural centre of distribution and collection for a large portion of that vast region. But there is an icy bolt drawn across the door, barring the way. Lake Winnipeg is a huge lake, an inland sea of some 300 miles in length and 50 or 60 in breadth. It receives the drainage of the fertile belt through navigable rivers, and it sends off that drainage towards the north through a large river—the Nelson—which pours its waters into Hudson's bay. The Nelson is, in fact, the continuation of the Saskatchewan. Lake Winnipeg is in the very centre of the continent. If ocean steamers could penetrate to that lake, it would be like dispatching a steamer direct from the port of London to the grain elevators of Chicago. It would be even better; for a vessel loading in Lake Winnipeg could take in her grain at the mouth of rivers penetrating to the very base of the Rocky mountains, navigable for a thousand miles through the richest land of the continent. Cannot this magnificent water system be utilized ? I fear not. There are two obstables which I am afraid will prove insurmountable. These are, the navigation of Hudson's straits and the navigation of the Nelson. Of Hudson's bay and straits we can speak with some

confidence, for the Hudson's Bay Company have for a long period sent two, and occasionally three ships every year to their two principal posts on Hudson's bay, namely, Moose factory, situated at the head of James bay, the most southern indentation of Hudson's bay, and York factory, which is placed close to the mouth of the Nelson river.

Hudson's bay is open for four or five months of the year. But Hudson's straits are not, and there is little comfort in having open water inside in the bay when you cannot reach it, and it is a poor consolation to know that the warm ocean is close to you outside, when you cannot get out. There are years in which the straits are not open for more than two or three weeks. Ships have occasionally failed to force a passage through the straits, and ships have been detained in the bay all the summer, unable to work their way out.

The average duration of open navigation of the straits is about five or six weeks in the year; you cannot depend upon more than that, though it may be open for nearly as many months. Of course, the substitution of steam vessels for sailing ships would make considerable difference; but even supposing steamers adapted to the purpose to be used, it must, I fear, be conceded that the navigation would be precarious, and the open season short. Moreover, the navigation is difficult and peculiar at the best of times, and it is doubtful whether ordinary steam vessels could be used, and problematical whether a trade could possibly be made to pay, requiring especially constructed ships, which would be idle for eight or ten months of the year. So much for the straits—now as to the rivers.

Formerly the Hudson's Bay Company transported all the peltry —that is, furs and skins—collected over a vast area, to Lake Winnipeg. Over that lake it was taken in large boats to Norway house, at the head of the Nelson, and down that river to York factory, at the mouth of it; and all supplies, all the necessaries and all the luxuries of life, all that white men and Indians required, were transported up the Nelson to Norway house, thence carried to various parts of the lake, and then disseminated through the land by boats, canoes and dog sleighs.

Some time ago the company abandoned the Nelson, adopted Hayes river, and have used that route ever since. Hayes river is not

an outlet of Lake Winnipeg. Properly speaking, it is a small river flowing into Hudson's bay close to the mouth of the Nelson. But the name Hayes river is generally given to that series of lakes and streams which constitutes the route for canoe and boat navigation between Norway house on Lake Winnipeg and York factory on the sea. In referring to the line of water communication at present in use between Lake Winnipeg and Hudson's bay, I shall therefore call it Hayes river. The Hudson's Bay Company use large boats capable of carrying ten tons burden; so I assume that Hayes river is the better river of the two, and the more easily navigated by vessels of any size.

Hayes river has a course of somewhere about 300 miles in length. In the course of that 300 miles there are 20 or 30 portages. That is to say, obstructions occur at average intervals of 10 or 15 miles, so serious as to necessitate the immense labor of dragging over land boats capable of carrying 10 tons and the merchandise within them. That does not sound like a waterway that could be navigated by steamers of any kind—as a matter of fact, Hayes river is a mere boat route. There remains, then, the great Nelson river, the outlet of Lake Winnipeg. The Nelson or Saskatchewan is a first-class river in point of size and volume of water, but it is not navigable. Although the average depth of water for about 90 miles is said to be 20 feet, yet it is stated that there is only 10 feet of water at the head of the tideway—a fact which of course entirely precludes ocean steamers from ascending the river. For vessels drawing less than 10 feet it is navigable for about 100 miles; but at that distance from the sea there is a rapid or fall that entirely puts a stop to navigation, and renders it impossible for vessels of light draught to descend the river from the lake to the sea.

I do not suppose that either the Nelson or Hayes river has ever been thoroughly and accurately surveyed, sounded or reported on by engineers with a view to future navigation; and so wonderful is the way in which man wars against nature by means of engineering skill that I should be sorry to assert that this route is now, and always will remain, impracticable. But I know that it presents great, and I fear it presents insuperable, difficulties. It is certain that the Nelson—a river which, as far as the volume of water discharged by

it is concerned, ought to be navigable for large ships—is rendered useless and impassible by obstructions which must be of a serious nature, seeing that the Hudson's Bay Company prefer Hayes river to it. Hayes river is merely a boat route, and not even a good one; for it contains, as I have before stated, 20 or 30 portages in some 300 miles. The fact, therefore, that it is better for large boats than the Nelson, does not lead one to form a very favorable estimate of the latter river.

Even without this direct communication by sea with Europe, Manitoba and the western fertile tract must become one of the most prosperous regions of the earth; and I think it affords a better opening for farming industry at the present time than any other district on the globe. If this route prove practicable, the prosperity of the country would be enormously increased; and it is to be sincerely hoped that the sanguine views of some writers on the subject may not prove fallacious. But until they are demonstrated to be correct it would be unwise to attach too much importance to them. Disappointed immigrants form but a dejected and heart-broken population, and the strength of a young country was never healthily fostered by delusive hopes, mistaken statements, or thoughtless exaggeration.

I have alluded to this vast fertile region only in connection with the advantages it offers to the grower of wheat, but it must not on that account be supposed that it is unfitted in any way for the raising of stock. On the contrary, it is a vast natural pasture land—the true home and breeding ground of the American bison, commonly called the buffalo. Formerly a vast herd of buffalo, numbering many millions, wandered through the continent; their range extending from as high as 60° north down to the southern parts of Texas. In winter they moved towards the south, migrating again northward with summer-time.

This vast herd is now entirely broken up, and buffalo are disappearing out of the land. All the Indians on the plains subsist by means of them, living on their flesh and making houses of their skins. Besides the thousands killed by Indians for food and robes, incredible numbers are slain every year by white hunters for the hides and horns. Owing to this indiscriminate slaughter, and to the fact that their pastures are cut by railways and intrusive settlements, the

herd has become permanently divided into three. One band ranges in British territory about the Saskatchewan, west of Red river settlement; the second over the middle western territories about the Platte and Republican rivers; while the third, or southern herd, roams through Texas and the neighboring States. As these the indigenous cattle of the country disappear, their place is to a certain extent taken by the cattle originally imported from Europe. The shaggy-headed, short-horned bison passes from the scene, and with it the painted whooping savage, naked himself and on a naked horse, pursuing his natural prey with bow or spear; and in their place come herds of long-horned, savage-tempered Spanish cattle, tended and driven by men wild to look at, strange of speech and picturesque in garment, but white men and very different beings from the Indian hunters that came before them. Though Texas may be called the home of the Spanish cattle, and though vast unnumbered herds pasture on its luxuriant grasses, yet States lying further to the north are more suitable for cattle-breeding purposes. A mountainous country, affording as it does shelter in winter and some variety of temperature, is better adapted to cattle than the plains, which are either parched by the summer's sun or covered with the snows of winter.

On the great plains extending west from Manitoba to the Rocky mountains, the snow does not lie so deep as it does in districts within the same degrees of latitude, but further to the south, and consequently that country is well adapted by nature for stock-raising. But until means of cheap transportation are provided, it cannot compete with other and less naturally favored regions; it cannot hope to vie with Colorado, Wyoming, and the other States and Territories that include the foot-hills and fertile plains, packs, and valleys that lie within the eastern ranges of the Rocky mountains.

So, while the Indian slept, I strayed in thought over hunting-grounds of the past, and marveled at the changes that had taken place and the greater changes yet to come, till my musings were interrupted by old John, who awoke, sat up, shook his long hair out of his eyes, pulled his old black clay pipe out of his belt, placed a glowing ember in the bowl, and commenced smoking, with that expressive sound, half sigh, half suck, that tells of perfect satisfaction.

"Why, old man, what is the matter?" I said; "have you been dreaming?" "Yes, sir, I dreamed very hard, very hard indeed, very good dream too; see moose soon, I know—big one too. I see a big ship, with a big hull all black, oh, black as pitch. I had a job to get on board, but I *did* get on board. It is all right, you'll get one pretty soon. My shoulders and legs ache awful bad, too, sir. I shall be carrying a heavy load of meat soon, I know." It is a curious fact that the strange conceit in "Alice through the Looking-glass," where effects are made to precede their causes, and the queen cries before she has pricked her finger, is actually believed in and recognized as a law of nature by many people. Indians and half-breeds are usually very shy of mentioning their superstitions, for they hate ridicule. If they do speak of them, they affect to laugh at them themselves. Time and again I have heard Indians declare as a joke that they could feel the muscles of their backs ache where the withy rope cuts into them by which they carry a load of moose meat, and declare that it was a sure sign that a moose was shortly to die. But though they affected to laugh, they in their hearts believed thoroughly all they said.

"Well, John," I said, "I hope your dream will come true; but, talking of dreams, what was that story you began to tell me the other day about the bullets?"

"Oh, yes, that was a very curious dream, that was; many gentlemen won't believe that story, but its true though. I was hunting with a gentleman long ago—in the winter time it was—and as we left the camp after breakfast, he laughed, and asked me what kind of dreams I had in the night. He wanted to know whether we should have any luck, you know, sir. He was a very funny gentleman; he used always to tell the cook at night, 'You give John plenty fat pork for supper, make him dream good.' Well, sir, I told him I had a very curious dream. I thought he fired both barrels at a cariboo, and that I caught the bullets in my hand and gave them to him. Well, he laughed at that, and said it could not be true, and that I could not dream good anyhow. But I thought to myself, we'll see. So we hunted all day, and in the afternoon came upon a large herd of cariboo out on a lake. We crept up behind some little bushes to within 60 or 80 yards, and then I told

the gentleman to put on a fresh cap—it was in the old days of muzzle-loaders, you know, sir—and shoot, for I could not get him any nearer. Well, sir, he took a long aim, and fired. The cariboos were all lying down on the ice, you know, sir, and they just jumped up and stood all bunched up together, looking about them. 'Fire again, sir,' I said, and he took another steady aim, and fired. Nothing hit, nothing down, away the cariboo went, tails up, not a sign of a wounded one among them. Every now and then they would stop and turn round to see what had scared them, and then off again in a minute. Oh! we might have got plenty more shots if we had had a rifle like what you have now, sir, but it took some time to load a rifle in those days, especially in winter time, when a man can scarcely take his fingers out of his mits—and so they got clean away. The gentleman was terribly mad, threw his rifle down, and swore he would never use it again. It seemed to me the shots sounded kind of curious somehow, and I thought I would just go and see where the bullets went to. I had not gone twenty yards, when I found the place where one of them had struck the snow. A little further on I found where it had struck again, and then where it had struck a third time, a little further on still. And so it went on, hopping in the snow, the jumps getting shorter and shorter each time, and the trail circling round as it went, till finally the track ran along in the snow for a few feet and stopped. And there I found the bullet, picked it up, and put it in my pocket. Well, having got one, I thought I would go and trail the other bullet: I soon found where that had struck. It acted just like the first one, and I picked it up also. So I went back to the gentleman, and as he was loading the gun, I said, kind of indifferent like, 'Just see if those bullets fit your gun, captain.' 'Yes, John,' he says, 'and suppose they do, what of that?' 'Why, captain,' says I, those are your bullets, and I picked them up. Now what do you say about my dream?' Well, he would not believe me until I showed him the marks in the snow, and he found that the bullets fitted his rifle exactly, and then he had to. Lord, sir, I have heard him tell that story scores of times, and he would get quite angry when people would not believe it."

So we talked and yarned till I grew sleepy and dosed off, some-

what against my will, for the nights are too lovely to waste in sleep. Nothing can exceed the beauty of these northern nights, a beauty so calm, grand, majestic, almost awful in its majesty, that there exists not a man, I believe, on the face of this earth with a spirit so dulled, or a mind so harassed, that he could withstand its peace-giving power. By day his troubles may be too heavy for him, but the night is more potent than any drug, than any excitement, to steep the soul in forgetfulness. You cannot "bind the sweet influence of the Pleiades," nor resist the soothing touch of mother Nature, when she reveals herself in the calm watches of the night, and her presence filters through all the worldly coverings of care, down to the naked soul of man. It is a wonderful and strange experience to lie out under the stars in the solemn, silent darkness of the forest, to watch the constellations rise and set, to lie there gazing up through the branches of the grand old trees, which have seen another race dwell beneath their boughs and pass away, whose age makes the little fretful life of man seem insignificantly small; gazing up at planet after planet, sun beyond sun, into the profundity of space, till this tiny speck in the universe, this little earth, with all its discontent and discord, its wrangling races, its murmuring millions of men, dwindles into nothing, and the mind looks out so far beyond, that it falls back stunned with the vastness of the vision which looms overwhelmingly before it.

The earth sleeps. A silence that can be felt has fallen over the woods. The stars begin to fade. A softer and stronger light wells up and flows over the scene as the broad moon slowly floats above the tree-tops, shining white upon the birch-trees, throwing into black shadow the somber pines, dimly lighting up the barren, and revealing grotesque ghostlike forms of stunted fir and gray rock. The tree trunks stand out distinct in the lessening gloom; the dark pine boughs overhead seem to stoop caressingly toward you. Amid a stillness that is terrifying, man is not afraid. Surrounded by a majesty that is appalling, he shrinks not, nor is he dismayed. In a scene of utter loneliness he feels himself not to be alone. A sense of companionship, a sensation of satisfaction, creep over him. He feels at one with Nature, at rest in her strong protecting arms.

As soon as the moon was high enough to shed a good light, Noel

and I walked down to a little point of woods jutting out into the barren to call. Putting the birch-bark caller to his lips, Noel imitated the long-drawn, wailing cry of the moose, and then we sat down wrapped in our blankets, patiently to listen and to wait. No answer; perfect stillness prevailed. Presently, with a strange, rapidly approaching rush, a gang of wild geese passed, clanging overhead, their strong pinions whirring in the still air. After pausing about half anhour Noel called again, and this time we heard a faint sound that made our hearts jump. We listened intently and heard it again. It was only an owl a long way off, calling to its mate in the woods. After awhile we heard a loon's melancholy quavering scream on the lake, taken up by two or three other loons. "Something frightens the loons," whispers Noel to me. "Mebbe moose coming. I will try another call;" and again the cry of the moose rolled across the barren, and echoed back from the opposite wood. "Hark!" says Noel, "what's that? I hear him right across the wood there," and in truth we could just make out the faint call of a bull moose miles away. The sound got rapidly nearer, he was coming up quickly, when we heard a second moose advancing to meet him. They answered each other for a little while, and then they ceased speaking, and the forest relapsed into silence, so deathlike that it was hard to believe that it ever had been or could be broken by any living thing. Nothing more was heard for a long time; not a sound vibrated through the frosty stillness of the air, till suddenly it was rudely broken by a crash like a dead tree falling in the forest, followed by a tremendous racket—sticks cracking, hoofs pawing the ground, horns thrashing against bushes.

There the moose fought at intervals for about two hours, when the noise ceased as suddenly as it began, and after a pause we heard one bull coming straight across the barren to us, speaking as he came along.

The moose arrived within about 50 or 60 yards of us. We could dimly see him in the dark shadow of an island of trees. In another second he would have been out in the moonlight if we had left him alone, but Noel, in his anxiety to bring him up, called like a bull, and the moose, who had probably had enough of fighting for one night, turned right round and went back again across the barren.

We did not try any more calling, but made up our fire and lay down till daylight.

The next night, or rather on the morning after, we called up two moose after sunrise, but failed from various causes in getting a shot, but on the day succeeding that I killed a very large bull. We had called without any answer all night, and were going home to the principal camp about 10 in the day, when we heard a cow call. It was a dead calm, and the woods were very noisy, dry as tinder, and strewn with crisp, dead leaves, but we determined to try and creep up to her. I will not attempt to describe how we crept up pretty near, and waited and listened patiently for hours, till we heard her again, and fixed the exact spot where she was ; how we crept and crawled, inch by inch, through bushes, and over dry leaves and brittle sticks, till we got within sight and easy shot of three moose—a big bull, a cow, and a two-year-old. Suffice it to say, that the big bull died ; he paid the penalty. Female loquacity cost him his life. If his lovely but injudicious companion could have controlled her feminine disposition to talk, that family of moose would still have been roaming the woods, happy and united.

I have wandered over a wide field in this paper, but there are still many things which I should like to have brought before the reader if there had been sufficient space. I should like to have given him one run with buffalo on the plains, and one really good exciting gallop after a herd of great Wapiti deer among the sand hills of Nebraska. I would fain have asked him to follow me to Estes park in Colorado, during a fourteen hours' stalk after the "biggest mountain sheep that ever was seen," and to try in the same locality for grizzlies feeding on heaps of locust, just under the snow line on the range. I wish I could have described a mountain lion which I once saw in the middle of a warm summer's night in Estes park, when I was lying awake in bed, and which I pursued some distance in the costume peculiar to that part of the four-and-twenty hours usually devoted to sleep. I might have carried him with me to Newfoundland, to stalk cariboo on the great barrens, and taken him on snow-shoes in the winter to track moose upon the hard wood ridges, when the forest is more glorious perhaps even than in the fall. I could have shown him glimpses of primitive life

among the French-speaking "habitants" of Lower Quebec, and the simple Celtic, Gaelic-speaking population of eastern Nova Scotia; and given him a peep into lumber camps and birch-bark wigwams, and talked much to him about Indians—that strange race, which, even when it shall have entirely disappeared, will have left an enduring mark behind it. Civilized nations have passed and left no sign, but the Indian will be remembered by two things at least—the birch-bark canoe, which no production of the white man can equal for strength, lightness, gracefulness, sea-going qualities and carrying capacity; and the snow-shoe, which appears to be perfect in its form and, like a violin, incapable of development or improvement. There are three inventions which the ingenuity of man seems to be unable to improve upon, and two of them are the works of savages—namely, the violin, snow-shoes, and birch-bark canoes.

It is natural that field sports should be appreciated here, for no other country affords such facility for their enjoyment. People are apt to depreciate some and overestimate others of the blessings which surround them. I have been asked to admire the way in which in this great city æsthetics are cultivated by planting out the streets tastefully with tall telegraph poles, and decorating them with advertising boards of minute variety of design and great beauty of execution; and to note the way in which the roadways are so constructed so as to afford the greatest amount of exercise in the shortest possible time to those driving over them—a great blessing to persons of a sedentary habit. Perhaps you do not all sufficiently appreciate these advantages yourselves. There can, however, be no doubt about the innumerable blessings with which this favorite land has been endowed, and not the least among them is that you can here exchange civilization for barbarism almost at a moment's notice. In your great cities a man may enjoy all that wealth, good taste, refinement, luxury, can give, and if sated with those pleasures, he can in three or four days be living a primitive life among actual savages, thereby obtaining complete contrast; or he can find change and variety enough among the woods, streams and lakes of those portions of unreclaimed land which are to be found in nearly every State. Contrast and variety is the salt of life, act-

ing not only as a relish, but as a preservative. If the body is kept in one position for a few moments, only the muscles tire; so does the mind when it is bound down to one attitude of thought. If you want to rest, to re-create alike bodily fibre and mental tissue, you must have change. Monotony is fatal to proper development of mind and body. The tendency of the age is towards centralization. It would obliterate individuality, and by polishing off all intellectual corners and mental peculiarities would iron out mankind into one smooth, starched, dull, monotonous whole. It tends to become unhealthily artificial, and the mind of civilized man cannot fail to benefit as much from a slight return to a more natural mode of existence as his body does from the natural exercise, the bracing air of the plains and mountains, or the pine-scented breezes of the woods.

When the reading was ended, hearty applause showed the interest with which the narrative had been followed. Dr. Hayes moved that a vote of thanks be tendered to Lord Dunraven for the evening of enjoyment which he had given the Society. He hoped, he added, that, after his return from Europe, Lord Dunraven would favor them with another paper on his hunting experiences in this country. The vote of thanks was seconded by Mr. Pierrepont in a lively and humorous vein, and carried unanimously.

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